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Speculation in Civil Flying

THE Air Ministry has found it necessary to issue an Order cautioning officers against investing in companies promoted to develop civil aviation without due enquiry. The text of the Order reads:—"It has been brought to the notice of the Air Ministry that companies are being promoted in connection with civil aviation after the War, and that prospectuses are being circulated by such companies amongst officers who are on the point of being demobilised. Before such officers invest their gratuities in such concerns it should be brought to their attention that the conditions governing post-War flying are still unsettled. Officers are, therefore, advised to apply for information to the Air Ministry or to seek other skilled advice before investing their capital in response to appeals of this nature, certain of which may not be *bona fide*."

This is a timely warning, and we strongly recommend it to others outside the R.A.F. for their careful consideration. It is perfectly true that the conditions are still very unsettled, and there is, further, a large amount of what may be justly called pioneer work still to be done before it will be safe for investors to lay down their money without making the most careful investigation of the *bona fides* of schemes which, on the surface, may appear extremely attractive. There may be money to be made almost immediately in certain flying enterprises. For example, some of the concerns which have obtained concessions to give "joy-flights" at popular holiday resorts may, provided they are not over-capitalised and are in the proper hands, pay their way and show a profit. On the other hand, there are the company promoting cash-snatchers who are out to capture the public confidence upon purely hypothetical figures. We assume that it is this class of enterprise the Air Ministry has in mind in issuing its warning, and if, in the interests of officers who have little in hand but their Service gratuities it can succeed in separating the sheep from the goats, it will have done well by its officers.

The larger schemes for development may, as a rule, be taken as being good and under sound auspices. But here again it must be pointed out that they are not schemes for the small investor who needs an immediate return on his money. They will undoubtedly pay in the future, but that future will almost certainly be postponed for two or three or even more years. They are, therefore, enterprises for the larger capitalist who has imagination enough to realise that the great future which lies before commercial aviation is not a thing of to-morrow, and that he must await his return, and even possibly endure disappointment in the meantime.

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Prince Albert and the Flying Services Fund

H.R.H. Prince Albert has accepted the chairmanship of the Flying Services Fund, which has done really magnificent work during the War in assisting the dependents of officers and men, ameliorating the lot of prisoners of war in enemy countries, and in generally extending a helping hand to those in trouble. As our readers

know, this fund was started by and has been administered under the superintendence of the Royal Aero Club, which has done its work worthily and well. At the present moment, nearly 200 widows and dependents of men in the Air Services are receiving benefits from the fund, while the whole education of over 150 children is being undertaken.

Although the War itself is over, its liabilities are still with us, and it is very much to be hoped that the aircraft industry, and others who may be directly or indirectly interested in flying, will not allow the fountain of munificence to dry up, but will, on the contrary, make an especial effort to place the fund on a solid, permanent basis as a thank-offering for our victory over the enemy and our deliverance from the gravest danger which has ever confronted the Empire. Let them remember that it was to assist in this deliverance that those who have left their nearest and dearest dependent on this fund laid down their lives cheerfully and with a full appreciation of what their sacrifice meant to those they were leaving. If only they will lay that to heart, we are confident that the fund will attain to dimensions worthy of the cause and of the Royal Prince who, an Air Service officer himself, has accepted the responsibilities his presidency of the fund imply.

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The Disposal of Obsolete Aircraft

A correspondent of *The Times* has raised a considerable stir by a description of the methods adopted at Henlow of dealing with obsolete aeroplanes. He says that new machines of various types, delivered by the makers complete with the exception of engines, are taken in hand by gangs of mechanics and women workers, who, armed with hatchets and hammers, break them up. The pieces, except the metal work, which is sorted and stored, are mostly gathered into bags, taken away, and used as firewood. In the House of Commons Sir Samuel Hoare drew attention to the same sort of thing which, it is alleged, has been happening at Farnborough.

As readers of FLIGHT are fully aware, we have never hesitated, and never shall hesitate, to speak plainly where we conceive that there is wanton waste in Government departments, or any other abuse, for that matter. But in this case we really do not think the Air Ministry officials are so greatly to blame. It is unfortunately inevitable that there should be a colossal amount of waste in connection with any war, let alone a war of the magnitude in which we have lately been engaged, and from which we have so recently emerged. In fact, all war *is* waste, and the only thing to be done about it is to reduce that waste to the lowest possible dimensions. Now, in the case of the aeroplanes which are the subject of these charges, what was the Air Ministry to do in the matter of placing orders for them? It was engaged in the task of beating the Germans in the air at a time when improvement and progress were being recorded every day, with the consequent effect that the machine which was the last word to-day was utterly obsolete to-morrow. Obviously, it could not stand still and wait for the ultimate design—it had to carry on with what was best at a given moment, and thus to place contracts for machines which, when delivered, might be obsolete. That is what was inevitable, and what has actually happened.

The next question that arises is that of what should be done with these surplus machines? Should they be retained in the Service; sold to private purchasers; or be broken up and the material used to the best advantage? Obviously, it is no use retaining them in the Service. Their very obsolescence demonstrates that at once. The next alternative is to sell them for what they will fetch as complete machines. Here we come up against a difficulty. Many, if not most, are of types which were adopted because of their adaptability to war, and are practically useless for civilian flying—and they would hardly make useful school machines. Numbers have been sold, but it seems clear that there are far more for disposal than there is a market for, and we are thus driven back on the third alternative, which is to break them up and salve what material is worth saving. It seems to us the principal reason which has led up to the incurring so much post-War waste is that we had succeeded before the end of hostilities in achieving a rate of production which was actually in excess of our needs as they finally determined themselves. We had to strain every resource of production to render ourselves overwhelmingly strong in the air. An Air Ministry that had failed in its task would have stood condemned, but it did not fail and hence the sudden termination of a War which, up to its last phases looked like going on indefinitely, has necessarily left us with a vast accumulation of material on our hands, and we have to adopt apparently wasteful expedients for dealing with it. That seems to us to be the beginning and end of the matter. We do not say that the methods of the Air Ministry might not be improved in detail, but on the broad question of waste we are not inclined to take a harsh view.

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The Civil Flying Regulations

In our correspondence columns we publish a letter from Col. Alec. Ogilvie dealing with our comments, in a recent issue of FLIGHT, on the Civil Aviation Regulations. It may be remembered that we queried the exact meaning of the Regulation concerning the approval of design by the Air Ministry, and expressed the opinion that it would be useful to have a closer definition of its meaning. Col. Ogilvie points out that the Regulation lays down that examination of design can only be made in respect of the safety of the machine, and only when the machine is intended for the carrying of passengers for hire or reward. He may be right in this, but that is not precisely the way we read it. What he appears to think is that the Regulation is concerned mainly with constructional details. We read it to mean that the whole design *qua* design is open to inspection and rejection if it does not meet the approval of the authority delegated by the Secretary of State. Thus, a designer might submit a design akin, let us say, to the Dunne, which does not accord with accepted ideas on design, and which might be turned down on its supposed demerits for any or no reason. It seems to us that there is an essential difference between approval of design and examination of a machine for safety of details. The fact that there appears to be a slight conflict of opinion in connection with the meaning of this Regulation seems to us to justify our suggestion that it requires a closer definition.

With regard to another point raised in the letter—the matter of pilots' qualifications—we do not agree with our correspondent that in the case of pilots using aircraft purely in a private capacity the Regulations allow that the Royal Aero Club's

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Brigadier-General H. R. M. BROOKE-POPHAM, C.M.G., D.S.O., A.F.C., Director of Aircraft Research

certificate is all that is necessary. The Regulations seem to be quite clear on the point that a certificate of competency issued by the Secretary of State is essential. Of course, there is nothing in the Air Force Act which prohibits the Secretary of State from delegating his authority to issue such certificates or licenses to any competent body he may select, but the point is he has not done so. For our own part, we are of opinion that there can be no objection at all to such delegation of authority to the Royal Aero Club, provided the club is willing to accept the responsibility. Its certificates for general flying were all that were necessary before the War, and there seems to be no valid reason why they should not be equally good now. Considering what the club has done for aviation in the past, it would be a graceful, as well as a fair act if the Secretary of State were to ascertain the club's views as to this question of the issue of licenses for flying other than public service.

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Another Cippenham?

According to a special correspondent who writes in *The Times* Trade Supplement there is to be found a practical counterpart of the Cippenham motor depôt at Halton Camp, near Aylesbury, where, he states, the Government is covering a large area with permanent buildings, and employing great numbers of men who fill the trains from Aylesbury, some of them travelling from London, the time occupied in travelling being paid for. The intention appears to be to build a school for the technical training of mechanics for the Air Service, but, suggests the correspondent, there is plenty of room at Woolwich where great numbers of men have been paid off. Mr. Churchill paid a visit to Halton recently, and is said to have exclaimed "Colossal!" Whether he referred to the scale of the enterprise or to the row there is likely to be in Parliament and the country if the scheme is what it appears to be is not explained.

For all we know, *The Times* correspondent may have discovered a mare's nest, but we suggest that, the statement having been made that Halton may be another Cippenham, an early opportunity should be taken of asking for a clear and definite statement as to what is actually going on and what are the intentions of the Air Ministry with regard to the camp. The precise purpose for which the works are designed and the amount of money to be spent on them must be disclosed without any more delay than can be helped, so that if there really is an Air Ministry Cippenham toward it may be stopped before it has gone too far. We certainly cannot conceive that a training school for air mechanics on any scale deserving the description of "colossal" is either necessary or desirable, particularly as no concrete scheme has been arrived at in regard to the post-War establishment of the R.A.F. Possibly this is another of the schemes decided upon as a War measure and dozed over until the sudden cessation of hostilities awakened officialdom to the fact that it had decided to do something to help win the War!

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More Examples of Official Inefficiency

How on earth anyone can be found to advocate the nationalisation of great industrial and commercial undertakings in the light of the disclosures that are being made almost daily of official inefficiency, amounting almost to criminal negligence, passes the understanding of the ordinary plain person who has no axe to grind. Day by day people are found to argue that there is only one way for the country to recover itself and that is to turn it into a huge State trading concern—a sort of apotheosis of State Socialism. They will argue by the hour that the most efficient and the most willing workers are those employed by the State, and that if you really want to put a great enterprise permanently and soundly on its feet there is only one thing to be done—nationalise it and make every employee an official. If only these people had the time to spare from their vapourings to read, and the sense to appreciate, such a document as the report of the Comptroller and Auditor-General on the accounts of the Ministry of Munitions they would probably be driven to admit that there might be two sides to official management of business concerns.

The Auditor-General cites one case of a contract for rolling plates which was placed on the basis of payment by the Ministry of: (1) cost of production; (2) £4 for every ton of finished product; and (3) bonus on reduced cost. The first item as defined in the contract terms, included an allowance for material lost in process, but as the material was provided by the Ministry *free of charge* it seems fairly clear that the contractor was "on velvet" until the Auditor-General stepped in and queried the matter. We could go on selecting examples of the most appalling slackness in dealing with the nation's money, but there is really no necessity since they have become commonplaces of official management. The almost inevitable conclusion that would be reached by any business man after a study of the Report would be that the official system of carrying on commercial affairs would ruin the wealthiest corporation in less than a year, and that the official mind is really incapable of running a duck farm as a business proposition. It is not so much the men as the system that is at fault. During the War we have seen the great Departments of State call in to their aid prominent business men—men who have made their mark in the commercial affairs of the nation. Yet in a very large number of such cases the system has proved too much for the man and he has retired in disgust from a task which he found impossible of accomplishment. In others the principal figure has not been strong enough to retire, or has conceived it to be his duty to stay on and fight an almost hopeless battle, with the almost certain result that he has failed and has lost reputation. Yet this is the soul-destroying system of bureaucracy which the nationalisers would fasten to the community, with its substitution of collective mediocrity for individual brilliance of intellect and executive capacity. It would be an excellent idea to placard the country with some of the more glaring examples of official ineptitude disclosed by the Auditor-General and allow the public to make its own conclusions as to the business capacity of the Government official and the adaptability of the bureaucratic system to commercial affairs. We dare prophesy that if this were done there would be very little more advocacy of nationalisation, save by the incorrigible Bolshevist Socialist minority.

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Hawker's Gallant Failure

As we go to press there is still no news of Hawker and his gallant companion, Commander Mackenzie-Grieve, who set out from Newfoundland on Sunday evening to essay the crossing of the Atlantic. There

is still hope that they may have been picked up by some vessel not equipped with wireless, and that in the course of a few days we shall have the satisfaction of knowing that these two valuable lives have not to be added to the long list of those who have made the great sacrifice in the cause of progress, and that Britain may stand where she does.

Whatever their fate, their's was a glorious attempt to show to the world that British pluck and determination are still as high as ever. They took a great chance, with their eyes wide open to all the possibilities, accepting them cheerfully as risks that must be faced if the high honour and traditions of the race are to be maintained. There is no doubt the start would not have been made had it not been for the wonderfully successful performance of the American seaplanes, carefully nursed and shepherded across the ocean by ships of the United States Navy —a performance which seemed to place in the greatest jeopardy the honour of being first across the Atlantic in the air, an honour we very rightly believe should fall to a British machine, piloted by a British aviator. The conditions for success were no better than they have been for many days past, but the news of the American success in the flight to the Azores and the knowledge that at least one of these machines, with the carefully-organised assistance at the disposal of the Americans, would probably succeed in making the crossing to Europe, quite naturally impelled Hawker and his companion to take a risk which in all probability they would not otherwise have accepted. It was a gamble with their luck—and luck failed them. Had it held, there is certainly more than a strong possibility that the crossing would have been safely accomplished. But the strong south-easterly gale which sprung up in the early hours of Monday must have drifted the Sopwith far to the northward of her proper course, in addition to which it, being a head wind, must have meant running the fuel endurance of the machine perilously close to failure, apart altogether from the northerly drift.

There is really nothing more to be said now. We can only wait in tense hope that these two gallant souls have been rescued by some passing ship. Theirs was the true spirit of adventure, which has done so much through all the ages to place our Empire in the proud position it holds before the world. They essayed the stupendous for the honour of the nation —and the nation knows and appreciates. It may be true that there was a substantial prize as the reward of success, but no one who thinks for a moment can imagine that this weighed an atom in the balance of their decision to start in circumstances which made that success no better than a gambler's throw. No—the honour of the Empire was at stake. There was danger that a record which we have marked for our own might fall to the airmen of a foreign though friendly nation, and in the minds of these two intrepid adventurers it was the most natural thing in the world that they should make a desperate attempt to retrieve it. And, no matter what their fate may be —whether the hope we have expressed finds justification in fact, or whether Hawker and Mackenzie-Grieve have paid for their surpassing gallantry with their lives, the nation whose honour and traditions they so worthily strove to uphold will for ever hold them in high esteem.

The American Triumph

It would be as churlish as it would be unfair to belittle the brilliant performance of the crew of the American seaplane, N.C.4, which succeeded in making the world's record overseas flight from Newfoundland to the Azores, and we can do no less than wish the gallant crew and their machine a speedy and safe consummation of the task they have undertaken. It was a wonderful flight and a wonderful organisation which enabled them to accomplish it. Regarding the Atlantic flight with large imagination and jealous almost to a fault of the honour of their great nation, the American naval authorities perfected an organisation without precedent in the annals of record attempts. They covered the face of the Atlantic with a fleet of destroyers and auxiliary craft, which, short of absolute failure of machines or engines, reduced success almost to a matter of mathematical certainty. Wireless signals, smoke screens, rockets, and every device known to the naval expert were impressed in order that success should be assured, and they have secured their reward, as, indeed, they deserved to do. Without the slightest disposition to be captious, we think it is nothing more nor less than fair to point out that the American flight and that of Hawker are in no way comparable. In the first case, everything that foresight and organisation could do to ensure success or to secure the safety of the airmen engaged in case of failure was done. The route was laid across a stretch of the Atlantic in which weather conditions are as stable as weather can be. In the other case, two solitary adventurers flew off into the void, knowing that there was no one to care for them or to succour them in case of failure. Success meant honour—failure a probable death in the wild wastes of the Atlantic. We will not, however, pursue the subject farther, but again congratulate our American cousins on the success of a brilliant effort, and wish them all the good fortune possible in the ultimate stages of their journey when the conditions warrant them in resuming it.

King Albert's Flights.

King Albert of Belgium, on May 15, arrived in England by aeroplane from Belgium, alighting at the Hawkinge aerodrome near Folkestone. On the following day he flew from Folkestone to Gosport in a D.H. 9 machine, from whence he continued his flight in a F. 2A flying boat to Dartmouth to visit his son at the Royal Naval College. About six miles before reaching his destination, King Albert's machine was forced to alight on the water owing to engine trouble, but the royal passenger was transferred to a second machine, which was acting as escort, and the journey was completed. The return journey to Dover was made on Saturday, and King Albert flew over to Brussels on one of the aeroplanes of the Folkestone-Cologne Mail Service.

Germans to be Excluded from the F.A.I.

The first meeting of the International Aeronautical Federation since the declaration of War was held on Monday at the Aero Club de France. Prince Roland Bonaparte presided, and the United States, France, Great Britain, Italy, Belgium, Norway, Holland, Sweden, and Switzerland were represented. It was an extraordinary meeting called to consider the position of the enemy countries, and it was unanimously resolved that Germany, Austria, and Hungary should be excluded from the Federation so long as they had not been admitted to the League of Nations.

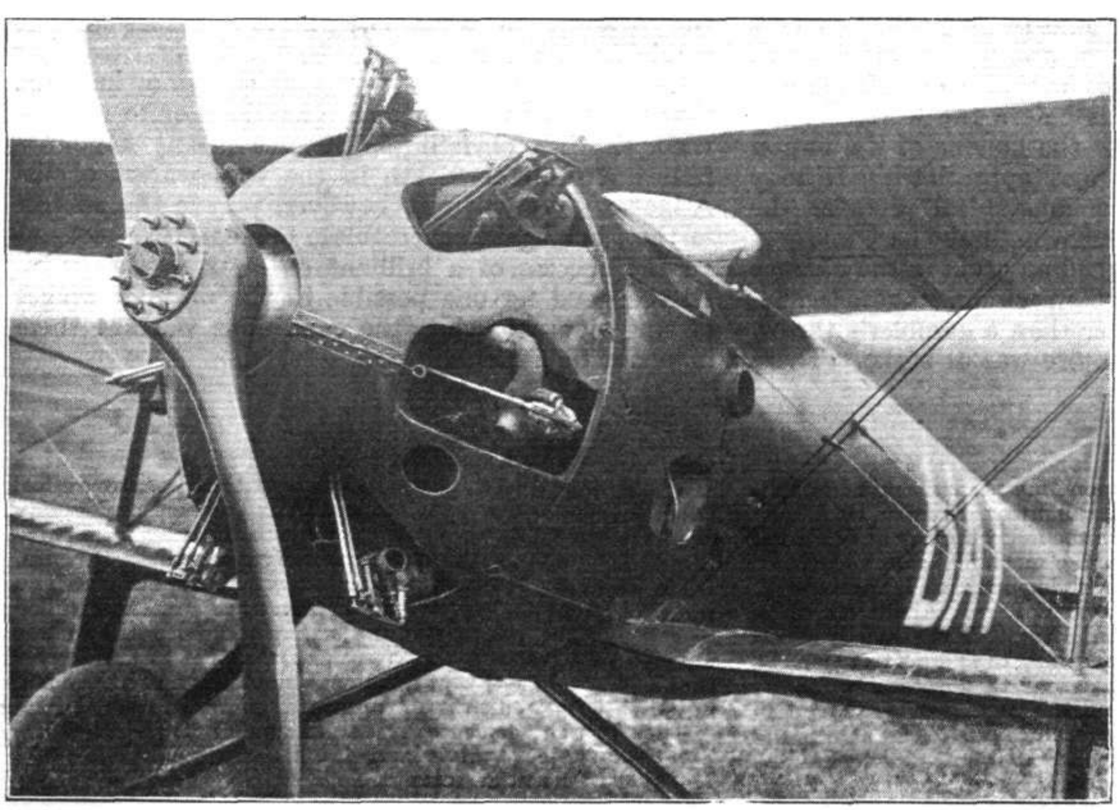
The British delegates were Lieut.-Col. M. O'Gorman, Lieut.-Col. Alec Ogilvie and Lieut.-Col. F. McClean, with Mr. H. E. Perrin, Secretary.

THE B.A.T. BANTAM

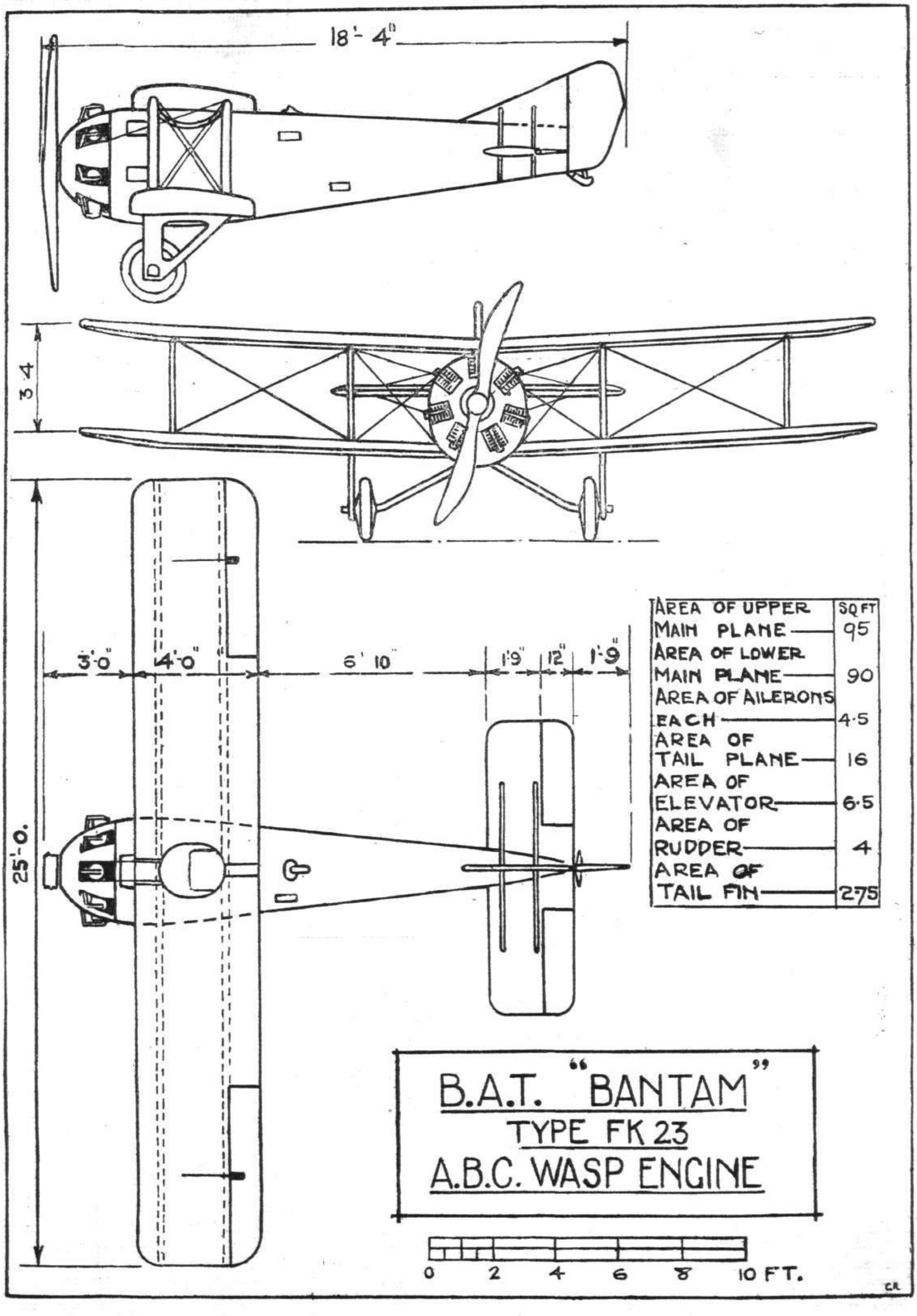
ALTHOUGH not, perhaps, possessing the interest of novelty, having been designed a matter of nearly two years ago, the B.A.T. Bantam nevertheless presents many features that are worthy of mention, so much the more so as we have been prevented, during the War, from describing this machine. Its detail features will not, therefore, be so well known to a large proportion of FLIGHT readers as they deserve to be, and consequently we trust that the following descriptive article may be found of interest.

THE B.A.T. BANTAM.—Three-quarter front view

Mr. F. Koolhoven, the designer of the B.A.T. machines, was, as is well known, chief designer to Messrs. Armstrong, Whitworth and Co. for a considerable time, and produced, while with that firm, some very successful machines of widely differing types. Previous to that, Mr. Koolhoven was associated with the British Deperdussin Co. at their works at Highgate, where, in the years before the War, some very successful monoplanes were produced. Among these was, it may be remembered, a monoplane seaplane, the "Seagull," which, among other features, was remarkable for the *monocoque* construction of its body, a form of construction not often seen in this country in those days. The body structure was found to be remarkably strong and light, while possessing an excellent stream-line form. It is not, therefore, surprising to find that Mr. Koolhoven, having been successful with *monocoque* construction so long ago, still favours this method in his later machines, such as the Bantam and Basilisk. The detail construction has been somewhat changed, and, perhaps, one may not, strictly speaking, be justified in using the word *monocoque* in its usually accepted sense. However, in so far as having no



The B.A.T. Bantam. View of engine housing



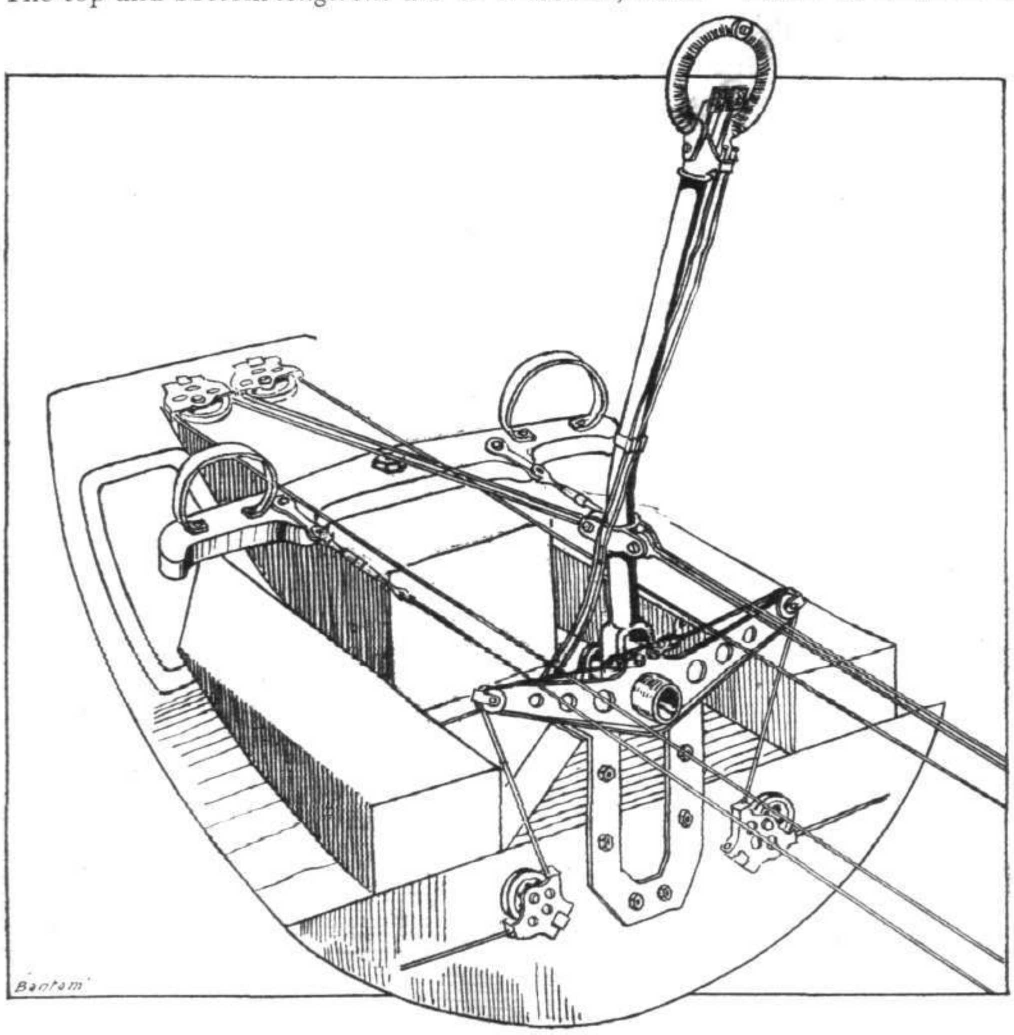
AREA OF UPPER MAIN PLANE	SQ FT 95
AREA OF LOWER MAIN PLANE	90
AREA OF AILERONS EACH	4.5
AREA OF TAIL PLANE	16
AREA OF ELEVATOR	6.5
AREA OF RUDDER	4
AREA OF TAIL FIN	2.75

THE B.A.T. BANTAM.—Plan, front and side elevations, to scale

internal bracing, except that provided by the *fuselage* covering, the B.A.T. Bantam, and also the Basilisk, may be said to have as one of its most noteworthy features a *fuselage* construction akin to the *monocoque*.

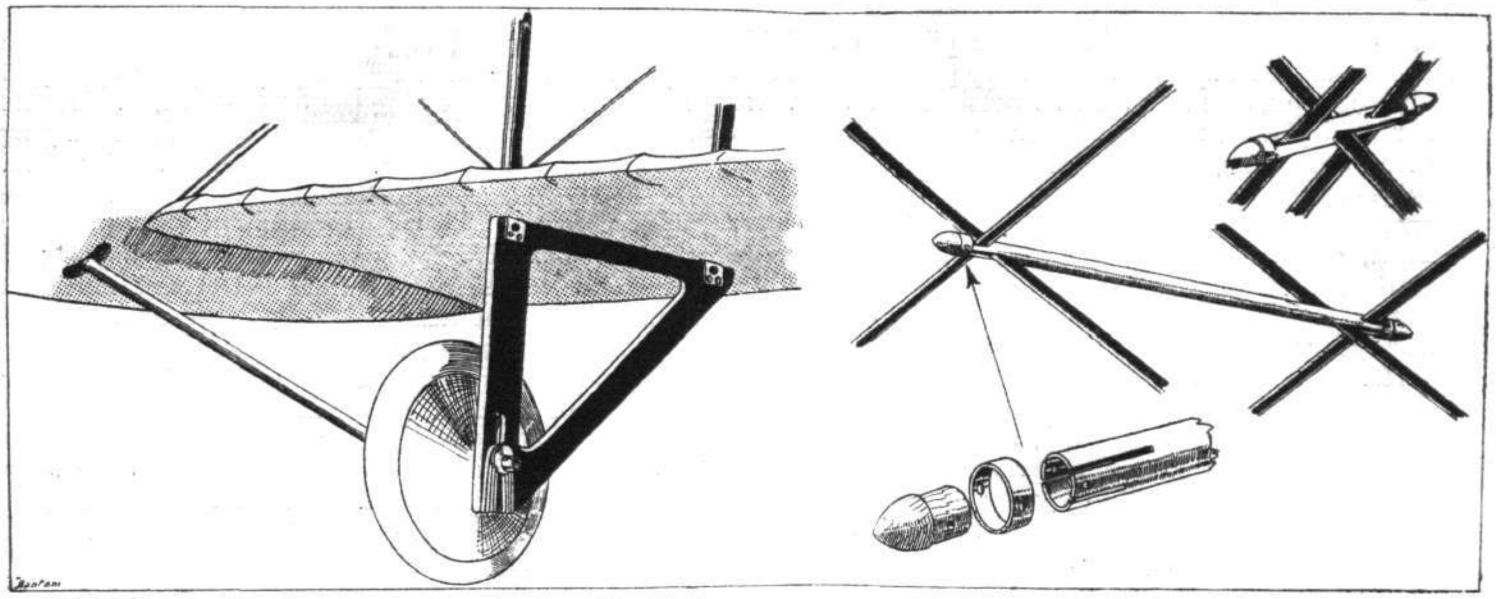
In the B.A.T. Bantam the *fuselage* construction consists essentially of a light framework, comprising six longitudinal members and a number of transverse formers built up of three-ply wood, the whole covered by a three-ply skin put on in bands some 3 ft. wide, lap-jointed where they meet. The outer and inner layers of this three-ply skin run longitudinally, while the middle layer is placed at an angle to the other two. The longitudinal members are of ash, and are placed as follows: one at the top, one at the bottom, and the other four forming the corners of the rectangle inscribed in the elliptical cross section of the body. The top and bottom *longerons* are of T section, while the other four are rectangular. Where the transverse formers are attached to the *longerons* the formers are reinforced for extra strength. The formers themselves are of L section, the ash base of the L lying against the *fuselage* covering. In section, the body of the Bantam changes from circular in front, through elliptical to narrow ellipse and vertical knife's edge at the stern. From a resistance point of view the shape would appear to be excellent.

At the rear the three-ply body covering is extended upwards to form the fixed vertical tail fin, the internal framework of which is integral with the body formers in this locality. The fixed tail plane is in two halves bolted to short spar roots built integral with the formers. A peculiarity of this design, which is somewhat similar to that of the Dep. "Seagull," is that the elevators do not go right up to the sides of the body, the space between the inner ends of the elevator flaps and the sides of the *fuselage* being occupied by a fixed portion of the tail plane. This will be clear from the plan view of the general arrangement drawings. As in the old Dep. monoplane, the elevator crank levers are housed inside the ply-wood fin, giving a very neat and clean appearance to the tail plane. The rudder is fabric-covered, as is also the tail plane and elevator, and forms, at its lower corner, a housing for the shock-absorbing spring of the tail skid. This skid turns with the rudder, but is so designed that, although superficially appearing to do so it does not transmit shocks to the tubular leading edge of the rudder, but to the fixed rudder post. For steering at low speeds on the ground, this arrangement is excellent, as the skid is capable of turning the machine at speeds so low that the rudder has not yet become operative. At the same time it would be difficult to imagine anything simpler or offering less resistance. As the angle of incidence of the tail plane of the Bantam is not made adjustable, the bracing of the tail consists simply of eight R.A.F. wires, four above and four below the tail plane.



THE B.A.T. BANTAM.—Sketch of the controls

The pilot's cockpit is situated between two strong formers, serving as supports for the wing spars, and access to it is gained through a circular opening in the top plane. When the pilot is in his seat his eyes are about on a level with the spars of the top plane, and he therefore has a very good view in all directions except straight down, where the bottom plane obstructs the view to some extent, although no more so than on machines in which the pilot is less favourably situated as regards the top plane. The controls are of more or less usual type, consisting of a central control column terminating at the top in the standard handle, and of a foot bar for the rudder. The manner in which the controls work will be clear from the accompanying sketches. Although the *fuselage* of

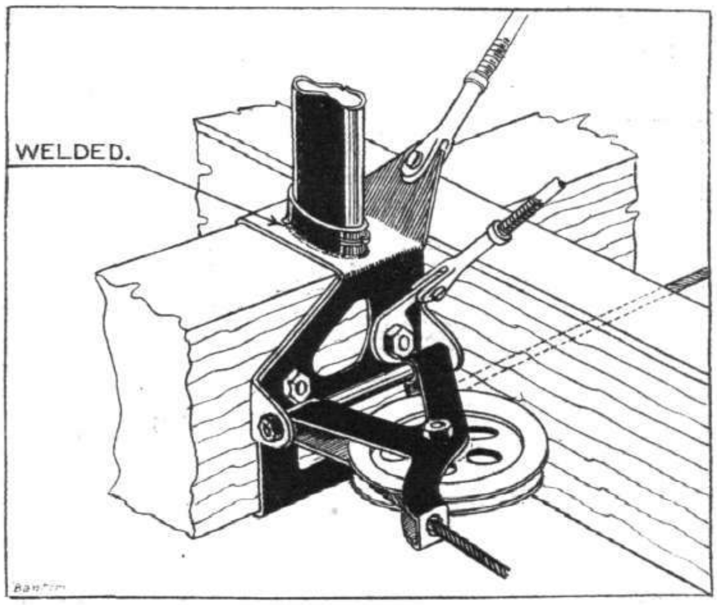


THE B.A.T. BANTAM.—On the left one side of the undercarriage. On the right the tubular guides which check vibration of the lift and landing wires

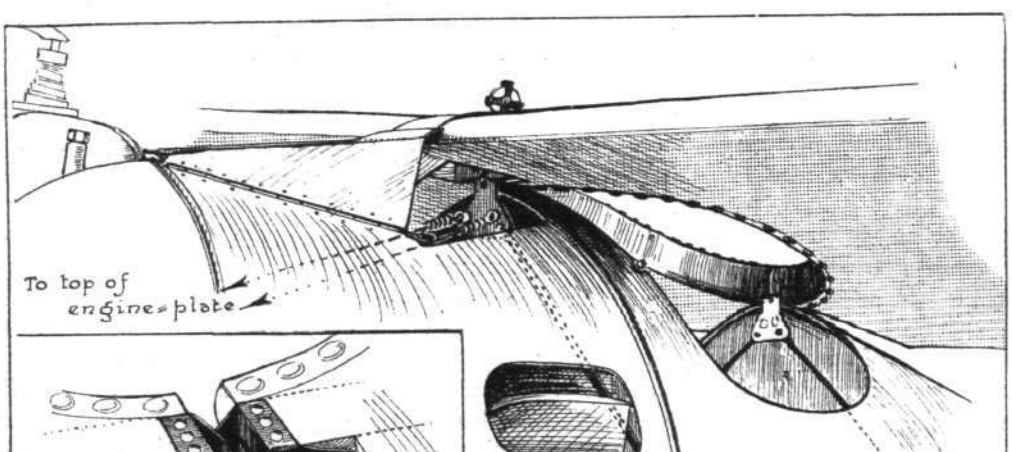
the Bantam is not of exceptionally great cross section, the pilot's cockpit is very roomy, this being one of the many advantages of the *monocoque* construction, which does not waste space on internal girders and bracing.

Mounted on a flat sheet steel capping plate over the extreme nose of the *fuselage*—the main structure of which is rectangular at this point, although made up to a circular section by the surrounding cowl—is the 170 h.p. A.B.C. "Wasp" engine. Slots in the cowling admit air to the cylinders, and the air escapes at the engine plate through various passages cut in the cowl. In so doing the air is forced to negotiate some rather sharp bends, which have, however, been avoided in a later type (the Basilisk), in which the air, after passing each cylinder, is allowed to escape *via* cone-shaped cavities in the engine cowling. The oil tank is mounted immediately behind the engine, while the main petrol tank, which has a capacity of $22\frac{1}{2}$ galls., is accommodated in the *fuselage* behind the pilot's cockpit.

With regard to the wings, these are mainly remarkable for a somewhat low gap-chord ratio. This is a



THE B.A.T. BANTAM.—Outer front inter-plane strut attachment to bottom spar, and hinge for *aileron* pulley



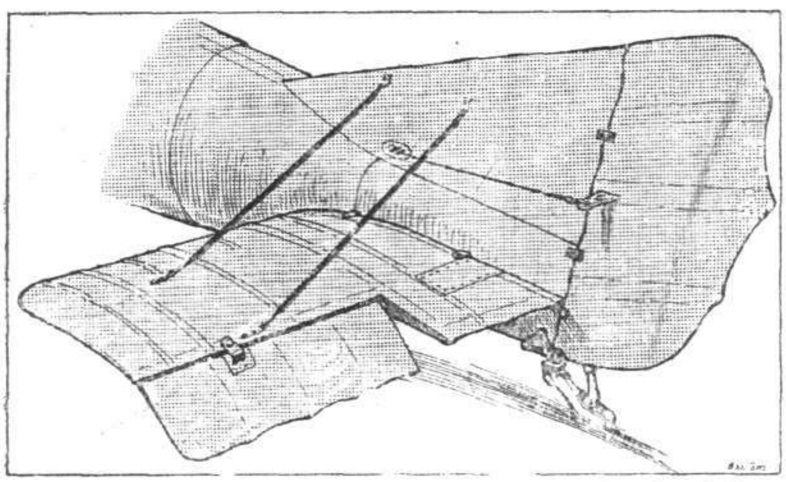
THE B.A.T. BANTAM.—The landing wires of the inner bay are attached to the lugs on the side of the *fuselage*, from which point steel straps run to the top of the bulkhead, connecting the external landing wires to the top spar attachment. Inset is indicated the manner of attaching the top spars to the top of the bulkhead

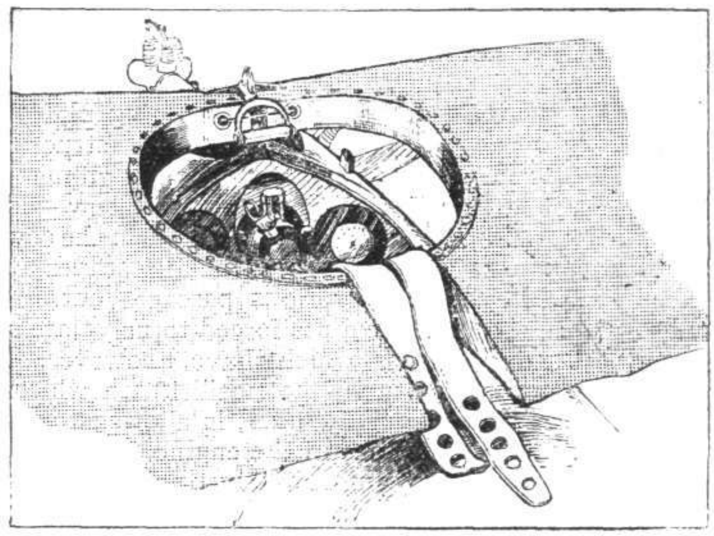
consequence of the placing of the pilot so that his eyes shall be on a level with the top plane, in order to obstruct to as small extent as possible the view. It is not, we know, usual to consider the gap-span ratio of an aeroplane, although, to our way of thinking, this ratio may easily be of as great importance structurally as is the gap-chord ratio aerodynamically. Thus, in a very high aspect ratio wing structure the gap-chord ratio may be the normal (about 1), but the gap-span ratio very low. The result of this will necessarily mean a less favourable angle of the lift wires. This in turn will have its effect upon the number of struts which it is efficient to employ. Thus, in the B.A.T. Bantam, although the span is low, the small gap results in a low gap-span ratio, and it will be seen that if only one pair of struts was employed on each side, the angle of the lift wires would have been very flat. It was further desired to provide a wide wheel track which would ensure that the machine could not easily be overturned when doing sharp turns on the ground, and with the steerable tail skid this machine is capable of some very sharp turns at speeds which, although below the flying speed, are quite high enough to be dangerous with a narrow track undercarriage. The designer then made the bold step of securing both these desiderata by a radical departure from usual practice. This took the form of fitting two pairs of inter-plane struts on each side and attaching the undercarriage struts to the spars at the point where occur the inner pair of inter-plane struts. In this manner, not only was a good angle provided for the lift wires, and the free length of wing spars reduced, but the resulting track of the landing wheels was so wide as to practically exclude any possibility of turning over. There was, in the earlier days of flying, a prejudice against attaching the undercarriage to the wings instead of to the *fuselage*, the argument being that landing shocks might seriously strain the wing structure without this being apparent until the machine was taken for a subsequent flight. In the B.A.T., however, one has a very light machine and a very sturdy wing structure, so that this objection—which is probably a rather theoretical one, after all—need not cause any misgivings. We have never heard of any ill effects arising out of this feature of its design during the two years or so of the machine's existence.

As regards the wing structure of the Bantam, this is designed along orthodox lines. The inter-plane struts, which are of elliptic cross-section steel tubes, are attached to the wing spars by a very neat and simple socket, and are held in place by a small split-pin. The manner of attaching the base plate of the socket to the wing spar is shown in one of the accompanying sketches. The wing bracing is effected by $\frac{1}{4}$-in. B.S.F. R.A.F. wire, the lift and landing wires in the outer bay, and the landing wires in the inner bay being single. The lift wires in the inner bay are in duplicate, so as to withstand better not only the flying loads, but also the loads imposed upon the wing structure while landing. In order to minimise vibration and prevent the wires from twisting under the force of the wind a neat arrangement is provided at the points where lift wires and landing wires cross one another. In the outer bay this takes the form of a long tube, slotted at its ends to accommodate the crossed wires, which are locked in position by an "acorn" and a collar with a split-pin, as shown in one of our sketches. In the inner bay where, as already mentioned, the lift wires are in duplicate, two short tubes are employed, one for each three crossed wires, as shown in the sketch.

The lower planes are attached to short wing roots built into the body integral with two very strong formers—one in front of the pilot's cockpit and one behind it. The two halves of the top plane are bolted to the apex of the same two formers, the detail of this attachment being shown in one of the sketches. The landing wires of the inner bay are attached to lugs on the side of the *fuselage*, these lugs being further braced from the top of the formers by means of long sheet steel strips in the manner indicated in one of our diagrams. In this way the rigging of these landing wires is greatly facilitated, while the steel strips transmit the load to the top of the formers. As already mentioned, the top plane has cut in it a circular hole, through which the pilot enters the machine, and by means of which he obtains a very good view in all but a downward direction. *Ailerons* are fitted to all four wings, and are operated in the usual way. The return cable is passed inside the top plane, and is exposed for a short distance at the front edge of the hole in the top plane.

The undercarriage of the B.A.T. Bantam is, as already pointed out, of unusual design. The two strut Vees are attached, not to the *fuselage*, as is usual practice, but to the lower wing spars at the points where occur the inner pair of inter-plane





THE B.A.T. BANTAM.—On the left a sketch of the *empennage*, and on the right the opening in the top plane through which the pilot enters the machine. The straps of the safety belt are shown flung back in readiness for strapping over the pilot's shoulders

struts. Each half of the divided axle is hinged to the body and bent just before crossing the slot in the V struts. These are built up of multi-ply wood and bound with fabric, while the axles are circular section steel tubes, stream-lined with a hollow fairing of wood bound with fabric. A notable feature of this undercarriage is the absence of wire bracing of the two V's. The function of bracing is performed by the axles, which really act as lateral radius rods for the V's.

On each side of the struts there is mounted on the axle a steel quadrant which serves the double purpose of housing the rubber cords and acting as guides limiting the lateral shifting of the V's. The whole makes a very neat and simple job, offering small resistance, and yet being quite strong. Whether this arrangement would be advisable in a large machine is, perhaps, open to discussion, but for a small, light machine like the Bantam it certainly would be difficult to improve upon.

The following particulars of performance, etc. should be of interest :—Weight of machine loaded, 1,335 lbs. Range, 425 miles. Speed near ground, 138 m.p.h. ; at 10,000 ft., 134 m.p.h. ; at 15,000 ft., 127 m.p.h. Climb to 10,000 ft., 7·2 mins. ; to 15,000 ft., 14 mins. Ceiling, 25,000 ft. ; landing speed, 50 m.p.h. ; load/sq. ft., 7·2 lbs. ; load/h.p., 7·85 lbs. ; military load, 520 lbs.

THE B.A.T. BANTAM.—Side view

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A Night Mail Carrying Experiment

AN interesting experiment in night mail carrying has just been carried out by the R.A.F. authorities. A D.H. 10 machine with two 412 h.p. Liberty engines from No. 120 squadron left Hawking Aerodrome, near Folkestone, at 10.30 p.m. and flying straight through without a stop reached Cologne at 1.30 a.m. The machine was piloted by Capt. Barratt, with Lieut. Fitzmorice as Navigation Officer and Lieut. Oliver as Observer. The course taken covered about 300 miles, and as there was a fairly strong adverse wind the performance at an average speed of 100 m.p.h. was particularly good. This squadron, in conjunction with No. 110 squadron at Maisconelle, the transference point in France, has been responsible for the regular Folkestone-Cologne mail service, which has been flown since March 1. During the period March 1-April 26 the squadron has carried no less than 1,634 bags of mails. In spite of exceptionally bad weather during a large portion of this period, particularly in March, there were only 10 days upon which mails were not carried. The total number of mail flights made in these 47 days was 289.

To Paris by Night

LEAVING London at ten minutes to one on the morning of May 15, the " Silver Star," a twin-engined Handley-Page with a load of mails, made a successful trip in good time to Paris. The machine was in wireless telephonic communication with the authorities throughout the journey, the connection with France being picked up as soon as the machine crossed the Channel.

From Mesopotamia in a Week

THE aeroplane is bringing the East very close to us, and Lieut.-Colonel Wilson, of the British Staff in Mesopotamia, has made a new record in flying from Mosul to England in a week. He was mounted on a D.H. 9A machine, and crossed the desert from Mosul to Cairo in one day, making three stops on the trip of 1,100 miles.

Belfast to Folkestone Non-Stop

ONE of the large Handley Page machines fitted with four 350 h.p. Rolls-Royce engines made a noteworthy flight on May 13, going from Belfast to Folkestone, a distance of about 500 miles in 7 hrs. 5 mins. Piloted by Mr. Clifford B. Prodger it left Belfast at 12.20 and flying by way of Larne, Carlisle, York, Darlington, Doncaster, Peterborough and Chatham, at a height of 9,000 ft., over clouds and fog, reached Folkestone at 7.25 p.m.

Aviation in India

ALTHOUGH India has done a great deal in the way of providing men and machines for the Royal Air Force, little has been heard of aviation in India. Report has it that steps have been taken by the Government in the way of arranging aerodromes, etc., in the neighbourhood of the chief centres, but nothing definite has been announced with regard to the policy to be pursued in connection with civil aviation. There are many difficulties of course, but it is to be hoped that the authorities will soon make up their minds as to what they intend to do.

A Sopwith in the Himalayas

A BRIEF message from Simla states that on May 4 Major H. A. Tweedie, R.A.F., had landed at the Annandale Gymkhana ground there, having flown from Amballa on a Sopwith " Camel." This is understood to be the first flight in the Himalayas.

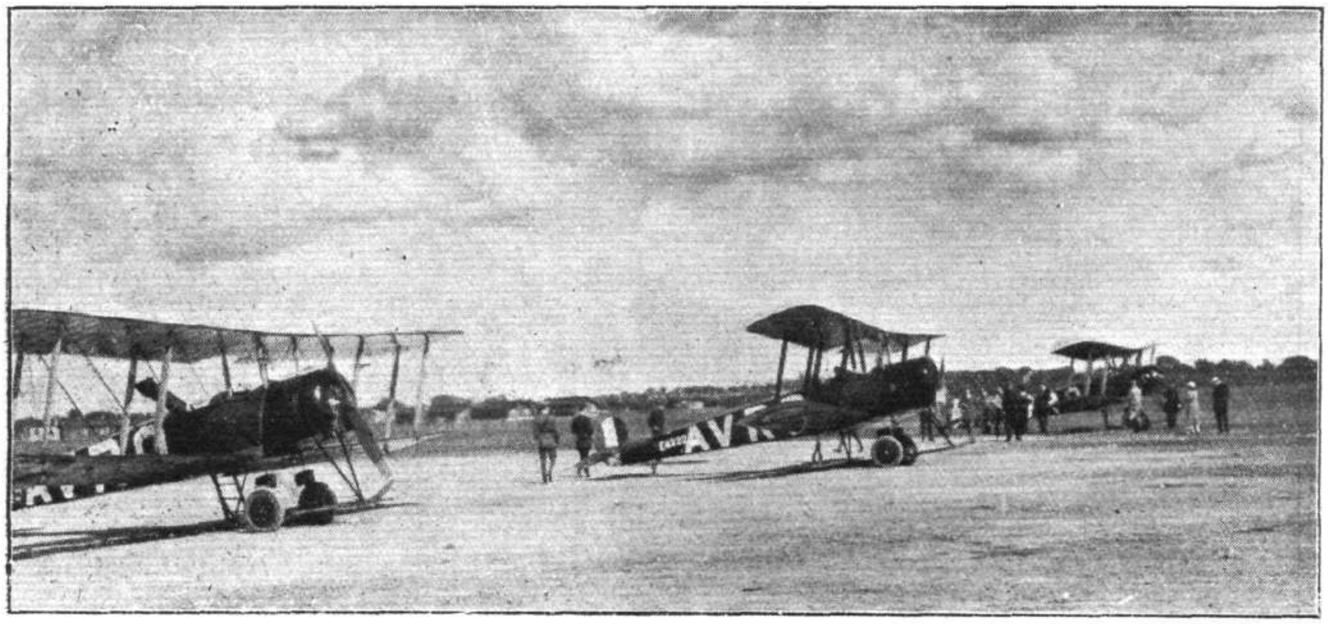
Testing a Parachute in Italy

FROM Rome comes word that a trial of a new parachute was carried out on May 9 over the sea off the port of Anzio. The parachute, with Lieut. Emerson, an American officer, who was also provided with a special collapsible pneumatic boat, was safely launched. Lieut. Emerson alighted on the water from a height of 420 metres, and then got into the boat.

CIVILIAN FLYING

CRICKLEWOOD

AT the Cricklewood aerodrome two Handley Page machines were busy all the week-end taking up passengers, among those carried on Saturday being Lady Hardwick. The two machines in commission were being piloted by Col. Douglas, Maj. Foot and Lieut. Walker in turn, some very fine flying being done. Especially one of the pilots, Col. Douglas, we think, did some very pretty banked turns, and was even seen to "hoyk" (how *does* one spell the word?) the H.P., a stunt which we had hitherto imagined to be outside the legitimate scope of a large twin-engined machine. The passengers, needless to say, thoroughly enjoyed their experience. In accordance with the new regulations, Government inspectors were on the spot to guard the safety of the passengers by frequent inspection of the machines. As one of the inspectors modestly put it, "We are a necessary evil"; and the four inspectors on duty—Capt. Rogers and Messrs. Owen, Cliff and Wood—performed their duties with tact and discretion.



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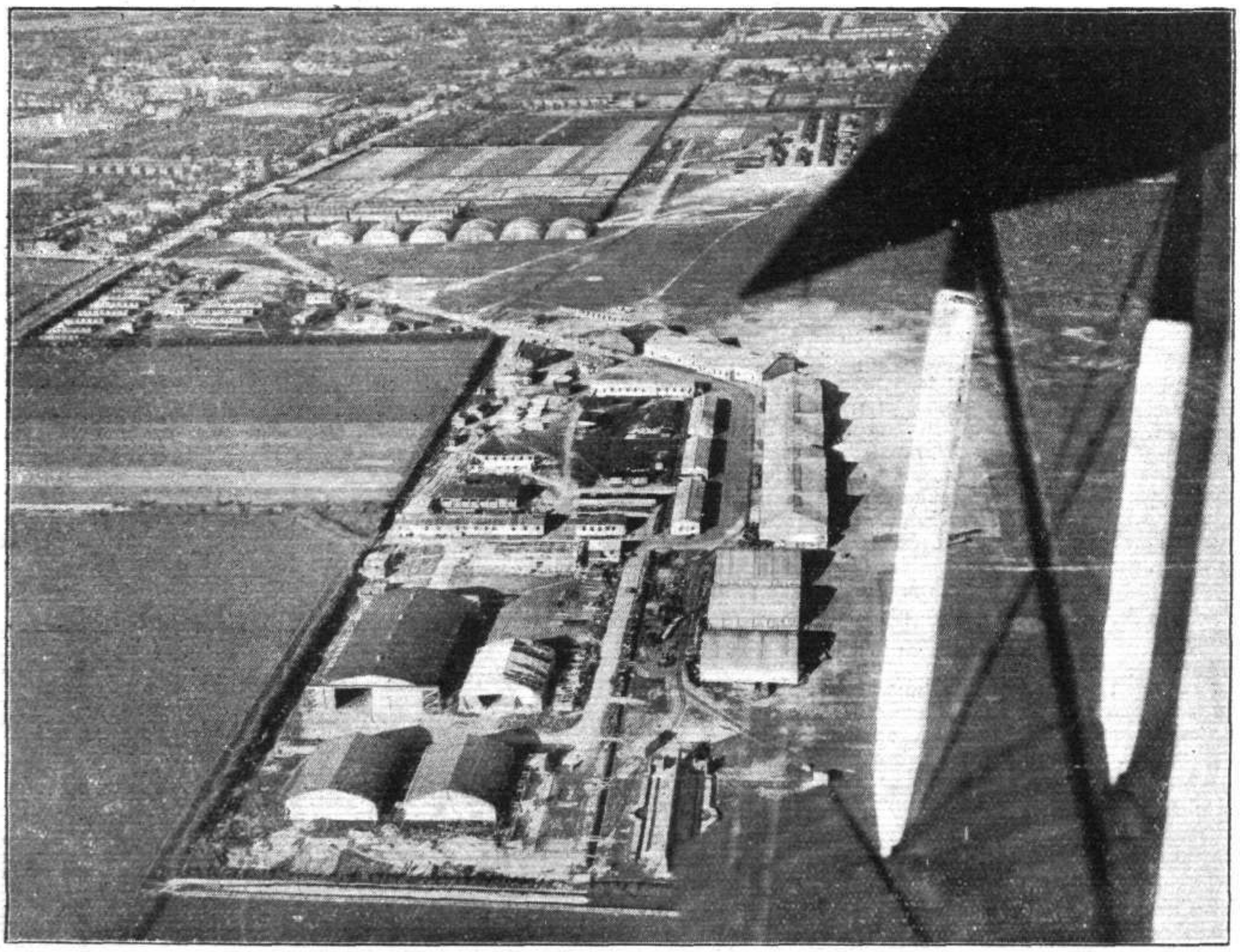
AT HOUNSLOW AERODROME : Civilian Flying : A trio of Avros filling up with passengers



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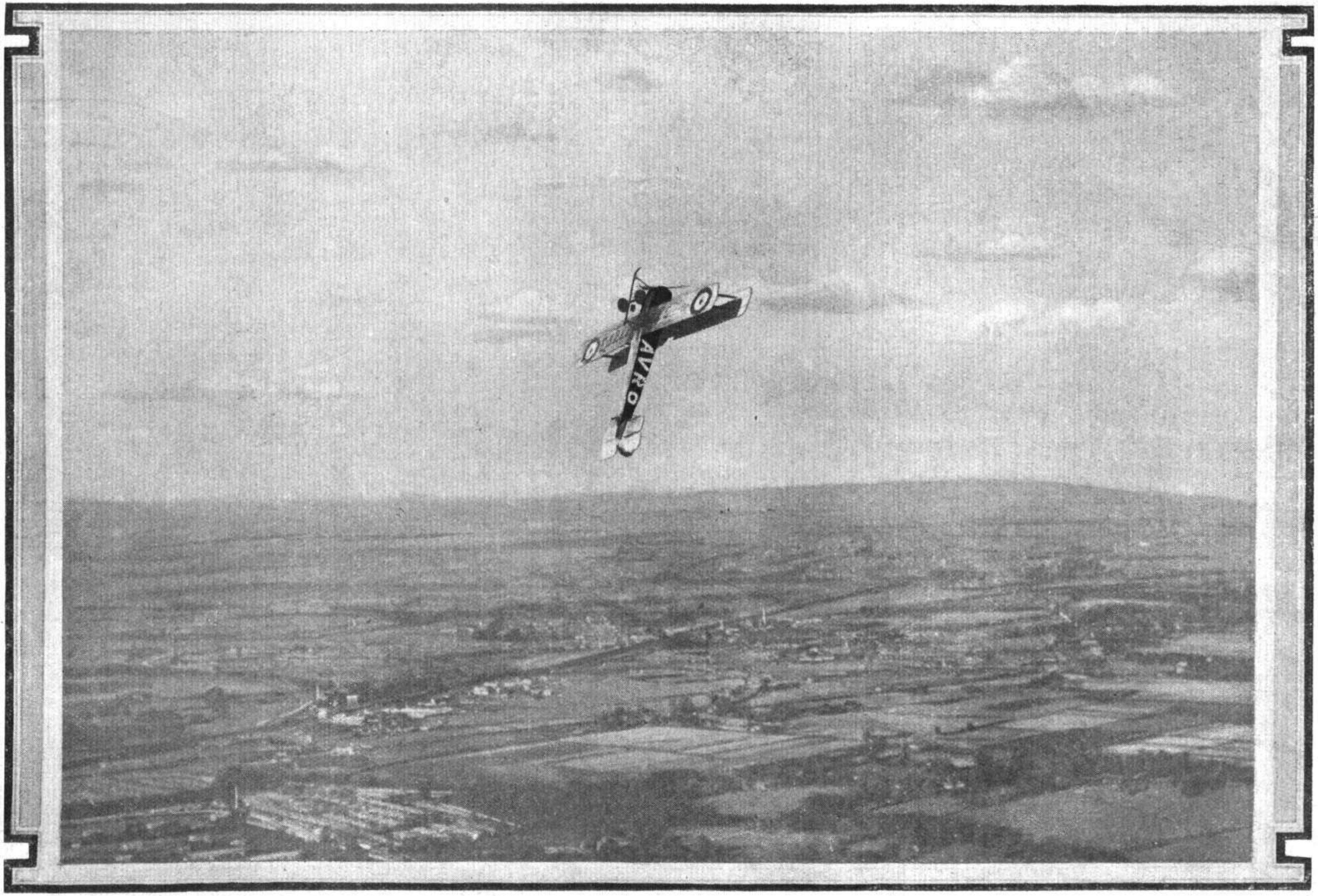
Hounslow Aerodrome as seen from above by the eye of "Flight's" Camera



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CIVILIAN FLYING AT HOUNSLOW AERODROME: Looping the loop in an Avro with three up. Photographed from another Hounslow Aerodrome Avro. An untouched negative

HENDON

There was a very good attendance at Hendon over the week-end, a great number of passengers being taken up for "flips" in the four Avro biplanes which, at present, constitute the G.W. stable available for passenger-carrying. Later on a number of other machines will be called into use. Thus there are now three Blackburn "Kangaroos" in one of the sheds being converted into passenger carriers. Pre-War visitors will still remember the G.W. school machines—pushers with a *nacelle* of the H. Farman type. Some of these are being erected, and will, we understand, also be seen at the aerodrome shortly. A batch of G.W. "Bantams" is coming through the works, so that, before long, there should be a good variety of 'buses available—something for every taste. In the meantime the four Avros are kept very busy, passengers being changed while the engines are kept running, stopping only to replenish the fuel tanks.

As mentioned last week, Hendon is gradually assuming its old appearance, and many of the old-time *habitués* and visitors are now seen there again at week-ends. Last Saturday we noticed among other familiar faces that of Mr. Ossipenko, who may be better remembered by his pre-War *nom de vol* Russel, and Mr. Summerfield, both old-time pilots.

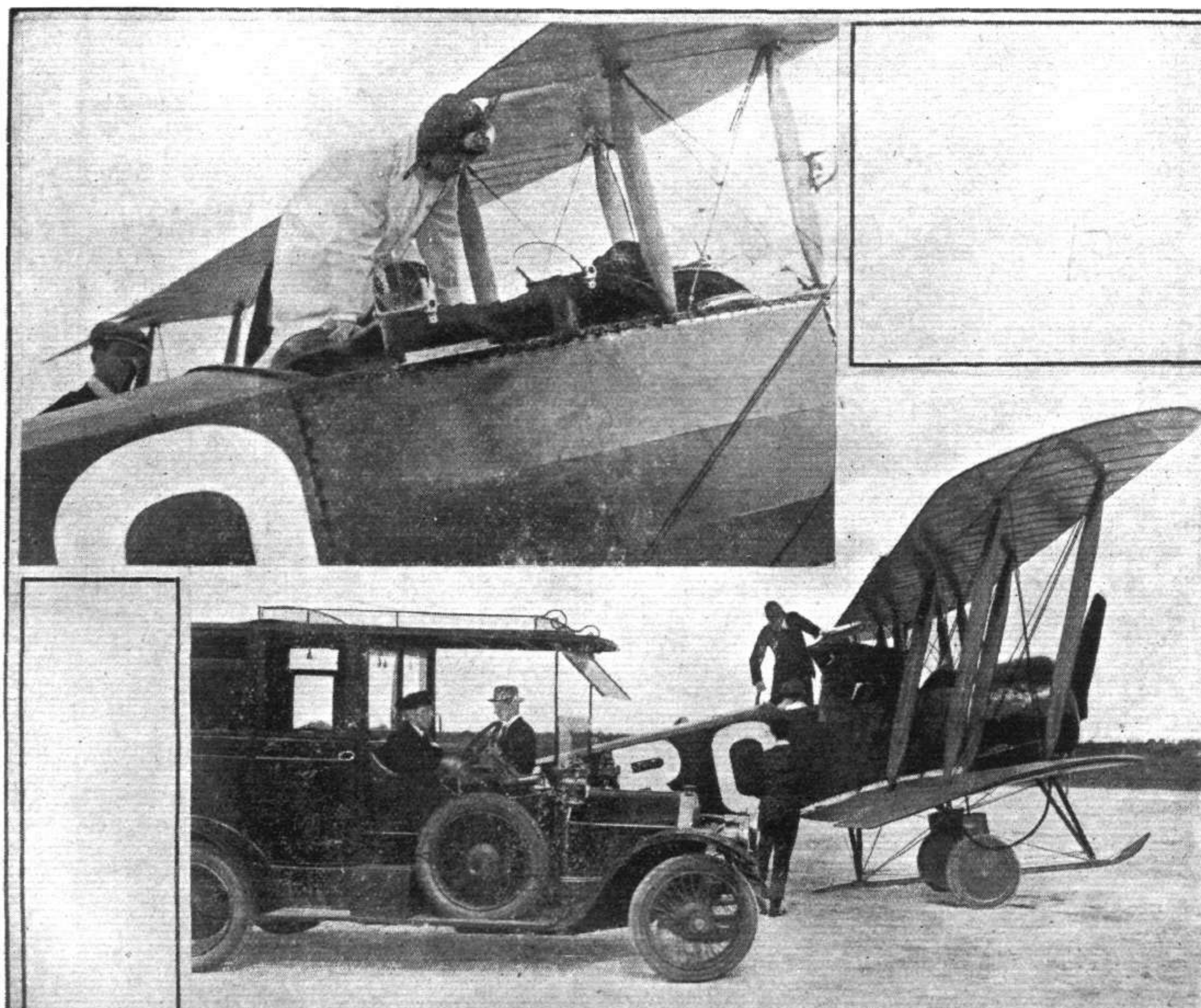
In a few weeks' time, when more machines are available, and when, as we hope, races will be held again, both around the pylons and cross-country, Hendon should soon regain the popularity it enjoyed before the War.

HOUNSLOW

There can be little doubt that the great "B.P." intends to participate in the joys of flying, and thanks to the enterprise of Messrs. A. V. Roe and others in introducing the "half-a-guinea flip," this is now brought within the reach of the multitude. At Hounslow aerodrome, during the week-end four Avros were kept exceedingly busy passenger-carrying until late in the evening. In fact, Saturday's log showed that about 100 passengers were taken up—the fair sex being very much in evidence. All sorts of flights were made, from the above-mentioned "half-a-guinea flips" to stunting (loops, etc.), as well as special cross-country flights. Two visitors, a lady and a gentleman, arrived by motor about 5 o'clock and left immediately on the 4-seater Avro for dinner and a return trip to Folkestone. Many youngsters—boys and girls—also enjoyed the thrills of flying, and we often heard requests to be taken up again! In the majority of cases passengers are carried in pairs—in the order of the number indicated on their tickets—but on several occasions four at a time were taken. Passengers are provided with coat, cap and goggles.

With the co-operation of Messrs. A. V. Roe, we were able to obtain some fine photographic records from the air of looping—taken from the "looper" by the "loopee," and from a sister Avro accompanying the looper. Two of these photographs are of special interest in that one was taken during a loop, showing the ground appearing below the tail, whilst the other photograph, taken at the same time from a second machine, shows the first machine executing the said loop!

Sunday was again busy, passengers being as plentiful as could be. Most of the passengers came from various London hotels and restaurants, special arrangements having been made with the latter whereby any of their guests desiring a flight, on booking for same, were taken to the aerodrome by car, and, after the flight, back again. During the afternoon some visitors left on one of the machines for Plymouth.



AT HOUNSLOW AERODROME: A quick service incident. A visitor and his wife arrived in their car, with only a very short time to spare for getting to Folkestone to dinner. In a few minutes they were *en route* for their destination, and before dark had returned to the aerodrome

THE FLIGHT TO AUSTRALIA

MR. HUGHES, Prime Minister of Australia, and Senator Pearce, Minister for Defence, acting in consultation with the Royal Aero Club, have decided upon the conditions for the proposed flight from Great Britain to Australia for a prize of £10,000 offered by the Commonwealth Government.

Though between 12,000 and 14,000 miles of land and sea have to be covered, the task, while it imposes a great strain upon the machines, does not present anything like the risks of the Transatlantic flight.

The route is by way of Alexandria and Singapore, at which places the competitors have to report for the identification of their machines. The airmen will presumably follow the course already successfully accomplished by R.A.F. Handley Page machines as far as India—across France, down the Mediterranean to Alexandria, thence to Bagdad, and on to Singapore. From Singapore to Australia the route will lie across the islands of the Malay Archipelago. The oversea flight will nowhere exceed a few hundred miles. Captain Ross Smith, M.C., D.F.C., a South Australian pilot, who was the first man to pilot a machine from Egypt to India, is already preparing landing-places between Singapore and Australia. His attempt will, however, be independent of the Commonwealth prize.

The competition is open to both aeroplanes and seaplanes, and the whole route must be covered inside 720 consecutive hours, and before midnight on December 31, 1920. The competing machines must be entirely constructed within the British Empire, but raw material may be obtained from outside sources. The pilots and crew must be of Australian nationality. The same machine must be used throughout the flight, but individual replacements and repairs may be made *en route*.

The start will be from Hounslow Aerodrome or Calshot Seaplane Station, and the finishing point will be in the neighbourhood of Port Darwin, in the extreme north of Australia. Towing on the water is not prohibited, but the total distance which the machine may be towed must not exceed 100 miles, of which not more than 50 miles shall be consecutive.

The flight will take place under the competition rules of the Royal Aero Club, which will supervise the start and control the competition generally. Entries must be sent to the Club, at 3, Clifford Street, London, W. 1, seven days before the start, and must be accompanied by an entrance fee of £100 towards expenses. Any balance will be refunded to the competitors.

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French Aerial Mails

THE following details regarding the working of the French aerial services have been given out by the French Bureau of Military Aeronautics.

On the semi-official Paris–Brussels line 34 trips have been accomplished, but more could easily have been carried out if necessary. On the Paris–Lille route, in 61 days between February 7 and April 10, 378 mail-bags weighing 78 tons were carried without accident. From April 1 to April 10 in 20 flights there was only one motor breakdown.

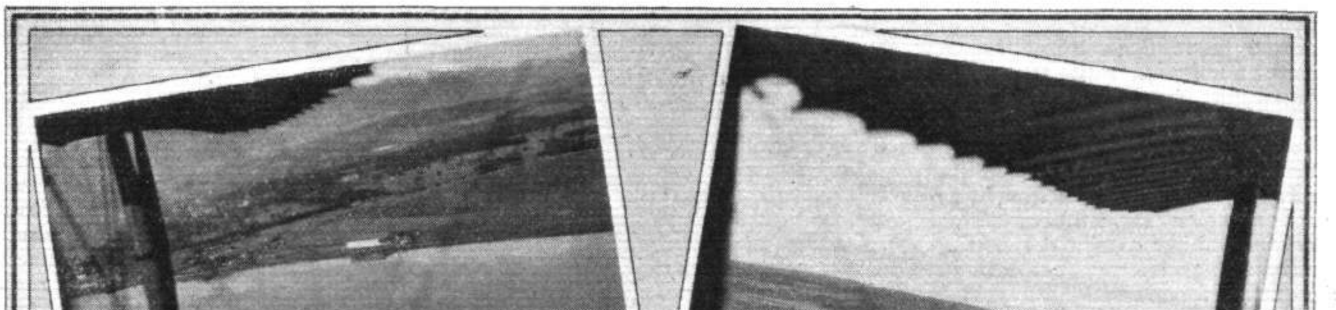
On the Paris–Bordeaux line, which is still in an experimental stage, from March 23 to April 29 there were 23 flying days, and 60 mail-bags, totalling 11½ tons, were transported. There were three smashes. The average time was four hours. The Paris–Strasbourg line, serving as a *liaison* with General Headquarters and the Government, between April 7 and April 13 made 15 voyages carrying 128 bags, dispatches and newspapers, totalling six tons.

Sweden and Visiting Aircraft

A PROPOSAL put forward by the Customs authorities at Stockholm, now being considered by the Swedish Government, would allow foreign aircraft to enter the country free of duty on the pilot's written undertaking to re-export the craft from Sweden within a certain time.

Leading Swedish Aviator Killed

SWEDEN has lost one of her leading pilots in Dr. Enoch Thulin, who was killed on the evening of May 14, when his machine fell from a height of 3,000 ft. near Landskronan. It was stated recently that the Thulin factory was to discontinue the making of aeroplanes, and would confine its activity to making motors and motor vehicles.



Four views of Alloa, where the British Caudron Co. have their factory and aerodrome, taken by René Desoutter from a G.3 Caudron (inset).

CORRESPONDENCE

LANDING GEARS

[1974] [The article on "Stresses in Landing Gear," by Mr. H. H. Thomas, published in our issue of April 10, has called forth some comments, printed below. Unfortunately it will not be possible to have a discussion on the article, since, we regret to say, its author has succumbed to an attack of influenza.—Ed.]

To the Editor of Flight.

Sir,—In the article on "Stresses in Landing Gear," by Mr. H. H. Thomas, in your issue April 10, he states in effect that if W is weight of an aeroplane in lbs., and V its vertical velocity of descent in feet per second at the instant of landing, and d the deflection of rubber absorber in feet, then $\frac{WV^2}{2g}$ = "average intensity of impact."

I have noticed a similar treatment of this question in "Design of Aeroplanes" by A. W. Judge (Second Edition), and I beg to point out a fallacy in the result.

The kinetic energy at instant of impact is $\frac{WV^2}{2g}$ ft. lbs., and in the process of absorption the wings and body of the machine (that is, practically W lbs.) descend d feet (the specified deflection), thereby losing potential energy approximately Wd ft. lbs. Hence, as both K.E. and P.E. are stored in the absorbers—at maximum deflection we have approximately $\left(\frac{WV^2}{2g} + Wd\right)$ ft. lbs. of stored energy (neglecting heat losses).

Since stored energy = work done,

We have $\left(\frac{WV^2}{2g} + Wd\right) = Pd$ approx.

$$P = \left(\frac{WV^2}{2gd} + W\right) \text{ approx.}$$

Where P = average intensity of impact.

F = maximum intensity of impact = 2P (assuming a linear law for rubber force — deflection) or $F = \left(\frac{WV^2}{gd} + 2W\right)$ approx.

Comparing this with equation (1) in article in question, we have a result greater by 2W approx. Actually the term 2W should be replaced by $2W_1$ where W_1 is the weight of all parts of machine which lose potential energy whilst the rubber extends owing to the pull of gravity W_1 lbs.

Equation (2) in the article is also in error.

If h is the height of "free fall" in feet (that is, from point of release until wheels first touch the ground), then K.E. at latter instant equals work done by gravity = Wh ft. lbs. During extension of rubber, W_1 the pull of gravity, still acts on the rubber over a distance d ft. (the deflection).

Hence stored energy (neglecting losses) = $Wh + W_1d$.

If P = mean force, $Pd = W h + W_1 d$

$$P = \frac{W h}{d} + W_1,$$

W_1 being of previous value.

Then $F = 2P = \left(\frac{2Wh}{d} + 2W_1\right)$ = max. force.

Equation (5), being deduced from (1), is, of course, equally in error.

Mr. Thomas states that "as the machine is necessarily moving forward however at the moment of alighting some portion of the weight would be borne by the wings." There seems an ambiguity here. The effect of the forward movement of the aeroplane is *taken into account* in the above solution, because V has been taken as the vertical component of the gliding velocity, and had there been no forward motion the machine would be "pancaking." The effect of forward motion has played its part in keeping V the vertical velocity small—or the same thing $\frac{WV2}{2g}$ small.

In the concluding portion of the article the author says in effect that owing to the frictional force F. tan β parallel to the ground coming in, "the vertical load will be increased in the ratio of sec β to 1." This is clearly wrong, since a force "*at right angles* to the force of impact" cannot produce *any* effect in the vertical load.

The total force of impact will be obviously

$$\sqrt{F^2 + F^2 \tan^2\beta} = F \sec \beta$$

and will act in a direction $\beta°$ to the vertical, where β is the angle of friction.

J. R. Pike, Wh.Ex.

The Stresses in the Landing Gear of an Aeroplane

Sir,—The recent article by Mr. H. H. Thomas on the above subject is somewhat misleading. He states rightly that the kinetic energy of a moving body is $\frac{WV^2}{2g}$, but since the kinetic energy of a body depends on the mass of the whole body, W being used as a measure of the mass must be the weight of the whole body (an aeroplane in the case under consideration) and not that part only which "is not air borne."

In a normal landing the velocity of the machine at the moment of impact with the ground will be such that the lift force on the planes is still equal to the weight of the whole machine.

Since the horizontal component of this velocity will not be reduced greatly during the first impact and rebound, it may be assumed without much error that the rate of loss of potential energy at any instant is equal to the rate of work done against the aerodynamic lift forces. The work done on the machine by gravity need not therefore be considered.

It remains to consider how the kinetic energy due to any downward component (V) of the velocity is converted into strain and heat-energy, and what proportion can reappear as kinetic energy on rebound.

Mr. Thomas assumes that all the kinetic energy is expended in stretching the rubber "shock absorbers." This is only correct when the tyres, axle, and other parts of the undercarriage are rigid and do not deform.

Even if this were the case in practice, the extension of the shock absorber does not usually follow a straight line law starting from zero, as the rubber is in most cases wound on with an initial tension, so that no extension is caused by the weight of the machine when at rest.

Had Mr. Thomas's calculations referred to the energy absorbed by the combination of tyres, axle and rubber, the assumption of the straight line law, starting from zero, would be roughly correct for some types of undercarriage.

Using this latter assumption, and the notation of the previous article, the maximum force which the undercarriage exerts on the machine will be approximately

$$F = \frac{WV^2}{d'g},$$

d' in this case being, not the extension of the rubber, but the total downward movement of the centre of gravity of the machine from the instant of impact till the vertical component V of the velocity becomes zero.

The force F will, of course, increase from zero to the maximum value during impact, and doubtless Mr. Thomas makes an unintentional slip in stating the reverse.

For any accurate determination of the stresses arising in an undercarriage from a landing under assumed conditions, or for the estimation of the most suitable proportions for the rubber shock absorber, data is required of the stress strain characteristics of the various component parts of the particular type of undercarriage under consideration. Information of this nature may be obtained with sufficient accuracy by subjecting the undercarriage to static load, and measuring the total vertical displacement of the load, and also the part of the vertical displacement which is due to the extension of the rubber.

By taking a series of these measurements for increasing and decreasing loads, strain energy diagrams may be plotted for the absorbed and restored energy between any desired limits.

For any given maximum force "F" let the total energy absorbed by the undercarriage be E, and the total energy dissipated be $\frac{E}{a}$.

Then $E = \frac{WV^2}{2g}$ and the energy restored will be $\frac{WV^2}{2g}\left(\frac{a-1}{a}\right)$.

Since this is in the form of kinetic energy the velocity (V^1) of rebound will be

$$V^1 = \sqrt{V^2\left(\frac{a-1}{a}\right)}.$$

This can only be zero when $a = 1$, *i.e.*, when all the energy absorbed by the undercarriage parts is dissipated. It is evident that this cannot be the case with rubber, and still less with the axle and tyres.

In the case of an abnormal landing with reduced horizontal component of velocity ("pancake" in the extreme case), the vertical component "L" of the aerodynamic forces on the planes may be less than the weight "W." In this case an additional amount of energy $(W-L)d^1$ must be absorbed by the undercarriage, before V is reduced to zero.

During rebound an amount of work $(W - L)d^1$ must be done on the machine before the tyres again leave the ground (where L^1 is the average lift force on the planes during rebound).

The total energy absorbed is then $\frac{WV^2}{2g} + (W - L)d^1$, and the kinetic energy when the wheels again leave the gound

$$\left[\frac{WV^2}{2g} + (W - L)d^1\right]\left(\frac{a - 1}{a}\right) - (W - L^1)d^1.$$

W. D. DOUGLAS.

Royal Aircraft Establishment, South Farnborough.
April 28, 1919.

SIR,—Your issue of April 10 contains an article by Mr. H. H. Thomas on the landing stress of an aeroplane which, though of considerable interest, is marred by some very inaccurate statements as to the gliding angle of an aeroplane. Mr. Thomas states that the gliding speed is such that "the work done by its flight is a minimum." It is, however, a well-known fact that a stable aeroplane can be made to glide at any chosen speed, between the stalling speed and the terminal velocity, by suitably adjusting the tailplane. On the other hand, an unstable aeroplane will not glide steadily at any speed when the controls are released. If the tailplane is so adjusted that the aeroplane is in trim at a definite attitude or angle of incidence α, the speed of flight V and the angle of glide γ are determined by the equations,

$$W \cos \gamma = k_L \rho S V^2$$

$$W \sin \gamma = k_D \rho S V^2$$

where k_L k_D are the lift and drag coefficients of the aeroplane.

Might I also point out that equation (5) and the subsequent calculation would have been simplified if Mr. Thomas had realised that

$$\frac{\tan^2 \gamma}{1 + \tan^2 \gamma} = \sin^2 \gamma$$

H. GLAUERT.

Farnborough, Hants. *May* 1, 1919.

Aerofoil Design

SIR,—In the course of an otherwise excellent article on Aerofoil Design in FLIGHT for April 17, 1919, your contributor, Mr. W. E. Astin, makes one mistake.

He apparently proves that by using a good section for the top plane of a triplane and taking all the lift on this plane and using symmetrical section non-lifting lower planes, the speed will be increased as compared with a machine of equal area having all three planes of the same section. The calculated increase in speed is about 15 m.p.h. This result is only achieved by using too small a drag coefficient for the symmetrical section.

It is a matter of experience that all high speed section such as used on modern scouts have nearly the same minimum drag coefficient, the only difference being that the nearer they are to symmetrical shape the nearer does this minimum occur to the angle of no lift. It is true that these machines usually fly at top speed at an angle of incidence slightly less than that at which minimum drag occurs and so a small gain might be expected by making one plane take more lift and so fly at minimum drag, while the other plane was altered to have minimum drag at a lower lift coefficient. If the lower plane is altered to have no lift, though its drag coefficient is decreased slightly by its being made symmetrical, the lift of the top plane will probably be so much increased that it will have passed to the other side of minimum drag, and its drag will be greater. A better scheme will probably be to alter both planes to a section having minimum drag at top speed, but even then the gain will be very small.

In my opinion the comparison the writer should have made to justify variable camber is not two machines of equal area, but with the same landing speed. The variable machine then uses for landing a section having about 50 per cent. greater maximum lift than the high speed section of the fixed machine; the planes are thus two-thirds the area, and at the top speed when the section has been altered to the same as the fixed machine the variable machine will be flying nearly at maximum L/D on both planes instead of maximum L/D for top plane and L/D = O for bottom plane as in Mr. Astin's machine.

One other point in his contribution needs mention. The question of a small oscillation of the machine at high speed causing down load on the planes. I fail to see why a machine with three planes only 2° above no lift is worse than one with one plane 4° above no lift and two actually at this critical point. Anyway the machine I suggest would be better than either in this respect. As a matter of fact, this question is not so simple as the writer supposes, but is bound up with the whole question of the stability of aeroplanes at high speed.

H. L. STEVENS.

Royal Aircraft Establishment, S. Farnborough, Hants.

THE CIVIL REGULATIONS

[1975] I notice in your leading articles of this week some notes on the Air Ministry Civil Regulations. The first query you raise is as to the approval of design by the Secretary of State. It is, however, laid down in the Regulations that such examination of design can only be made in respect of the safety of the machine, and that only when the machine is intended for the carrying of passengers for hire or reward. I think it fairly obvious that some authority must do this work, and cannot imagine passenger-carrying aircraft taking the air without approval of design, and whilst flying trials are, of course, useful, yet they cannot possibly be expected to take the place of a detailed examination of the machine. It is quite possible for a machine to pass its flying trials satisfactorily with inherent defects which a thorough system of stress calculation and checking would have revealed, and which defects would undoubtedly lead to disaster at a later date; instances of this occurred many times during the War. Your remarks, of course, are perfectly true that a prejudiced Government official, or one not perfectly familiar with the progress of aeronautical science, might unduly hamper legitimate development, but this risk must be taken, and also, in the event of such a thing happening, the constructors are in a position to obtain redress. I have not heard that the regulations of the Board of Trade in respect to passenger-carrying steamships have unduly hampered or restricted advance in the design of steamships, and judging by the wonderful advance that has been made during the last 20 years, it seems reasonable to suppose that, on the whole, the very wide powers of the Board of Trade are non-restrictive.

With regard to the qualifications for pilots using aircraft purely in a private capacity, and not carrying passengers or goods for hire or reward, the Regulations are framed on the principle that the pilot must, of course, show a certificate of a recognised body, such as the Royal Aero Club, in order that he may not be a danger to other people, either in the air or on the ground. Apart from this, he may push off into the air on any old machine he likes, with full power to break his own and his friends' necks without let or hindrance.

As concerns routes and prohibited areas, the map that was published was perhaps somewhat misleading, as it created in the minds of some people an idea that flying had necessarily to be restricted to the lines shown; but this is not so. Anybody can fly anywhere in the country from point to point providing that he does not pass over any of the forbidden areas, and also, if he is carrying passengers or goods for hire or reward, he starts from and proceeds to "recognised" aerodromes. The private pilot can, of course, land anywhere, but he is always liable under common law for any damage that he may do. The lines were doubtless shown on the map merely to indicate that along those routes aerodrome facilities could be obtained, including in some cases the services of mechanics and the supply of stores.

ALEC OGILVIE.

Ogilvie and Partners, 104, High Holborn, W.C. 1.
May 12, 1919.

General Sykes Flies to Paris

As evidence of the welcome convalescence of Major-General Sykes it may be noted that he resumed his duties at the Air Ministry on Saturday last, and flew over to Paris on Monday afternoon, leaving Kenley Aerodrome at 4 p.m., and reaching Buc Aerodrome, near Paris, at 6 p.m.

General Sykes is still in medical hands as the result of the smash in which he was involved on May 3, but it is hoped that he will soon be completely restored to health.

Aerial Forest Patrols in United States

DEFINITE steps have now been taken in the United States in connection with the use of aeroplanes for fire patrol work over the national forests. It is stated that the service will start operations on June 1.

Game Shooting from Aeroplanes

IN vetoing a Bill which sought to prohibit the shooting of game from aeroplanes, Governor Edge, of New Jersey, U.S.A., declared that he was against burdening the statute books unnecessarily, and expressed the opinion that the noise of aeroplanes was in itself adequate protection.

AIRISMS FROM THE FOUR WINDS

FOLLOWING the parent lead, Canada is making provision for nursing and taking proper control of aeronautics in the Dominion. To this end a Bill was last month introduced into the Canadian Parliament by the Hon. A. K. Maclean, on behalf of the Government, authorising the appointment of an Air Board for Canada. Subject to local application, the provisions for Air legislation follow largely the lines of the Home Government Bill. The Board is to consist of not less than five nor more than seven members. It will be appointed by the Governor-in-Council. The chairman will be a Minister of the Crown and the Departments of Naval Service and of Militia will each be represented.

Generally speaking, the Board will supervise all matters connected with aeronautics. It will study the development of aeronautics in Canada and other countries and undertake such technical research as may be requisite. It will construct and maintain all Government aerodromes and air stations. It will investigate all proposals for the institution of commercial air services within or partly within Canada or the limits of the territorial waters of Canada. The Board will also draft for the approval of the Governor-in-Council such regulations as may be necessary for the control of aeronautics.

It is further proposed to give to the Air Board certain powers of regulation and control over aerial navigation and to that end will be entitled to license pilots and all other persons engaged in the navigation of air craft. Provision is made for suspension and revocation of licences. There will be registration and also licensing of aircraft, aerodromes and air stations.

The Air Board will lay down conditions under which aircraft may be used for carrying mail, goods and passengers, and will be empowered to license commercial services.

It is suggested by the Government that after a year's trial it may be found that further legislation will be necessary.

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IT is to be hoped that aerial organisation at home and in all parts of the Empire will continue unabated, in spite of Leagues of Nations and other dreams of idealists. That war will end with the signing of Peace in the near future is an absolute fallacy, and perhaps it would be as well to take note of the less optimistic visualisers' views rather than pin too much faith to the permanent peaceful provisions which might be. Else may Britain find herself in as big a hole again as she did at the outset of the onslaught of the hellish Huns. Mr. Henry Morgenthau, who for some time was American Ambassador to Turkey, like a good many other authorities has great misgivings as to a "peaceful future." He is well qualified to judge the simmering ambitions which still sway the innermost minds of certain nations, and, at a lecture given but recently at Coblence, he sounded a note of warning against too much optimism even when the Huns' signature is attached to another piece of paper.

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THE present time, said Mr. Morgenthau, is one of suspension of hostilities, but please do not go home and tell the people that wars are over. We have to prepare for a greater conflict, a greater sacrifice, a greater responsibility. The manifold and conflicting demands of all the nations at the Peace Conference are impossible of fulfilment. Many delegates to the Conference will leave Paris dissatisfied. The nations are going to have further quarrels and disputes. I believe that within 15 or 20 years the U.S. will be called upon to save the world.

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WHICH, having regard to the fact that the object of the lecturer was to urge the younger generation of the U.S. to keep themselves physically fit for the future, is quite all right, but in the meantime the nation which waits for some other nation to save her may find herself up against some ugly snags in the process, which she may well avoid by looking after her own welfare, with discretionary forethought. Therefore more power to the national initiative which insists upon progress and ever more progress for power in the air, both with the Imperial Government and with every individual unit of that Imperialism.

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EVIDENTLY Mr. Johnson, who at Arcadia, Florida, is reported to have just made 457 consecutive loops in a Lapère two-seated fighter, has mistaken his vocation in life. He should have applied his talent to something more worthy of such an effort by taking up jazzing.

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How the vane on Epsom clock tower, which has just been straightened by a steeplejack, came to be bent at all, is a local mystery of some moment. Is there a low-flying pilot who can elucidate the matter? There *have* been some funny stunts around this district, and after all the shaving of such a precious item might well come within the ambition of some adventurer, vain of his stunting prowess. One never knows.

At the R.A.F. "War in the Air" Exhibition at the Grafton Galleries: The "All-Highest" in silk. An untouched photograph of two parachutes descending. Note the remarkable resemblance to Count William of Hohenzollern (the *ci-devant* Kaiser), even to the upturned moustachios.

A "BRISTOL" SCOUT, TYPE F, FITTED WITH 315 H.P. COSMOS "MERCURY" ENGINE: During recent tests at Farnborough this machine attained a speed of 143 m.p.h. at 10,000 ft., to which altitude it climbed in 5 mins. 25 secs. A height of 20,000 ft. was reached in 16 mins. 15 secs. It should be mentioned that this performance was attained without military load, the weight being 1,692 lbs.

AT the present price of eggs we hardly think it worth while having our weekly consignment of new-laids delivered *via* the air *à la* Eddie Stensom methods in Atlantic City. While flying 70 m.p.h. at a height of 700 ft. Eddie, so the wireless runs, "tossed" over a crate of eggs without smashing any. Apparently this little episode is not necessarily a fresh commercial proposition, but was, the message informs us, to test a new style of parachute.

"*Cuius solum est eius est usque ad caelum et ad inferos*" (old legal authority).

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"WHO owns the surface owns it up to heaven and down to the depths" (translation).

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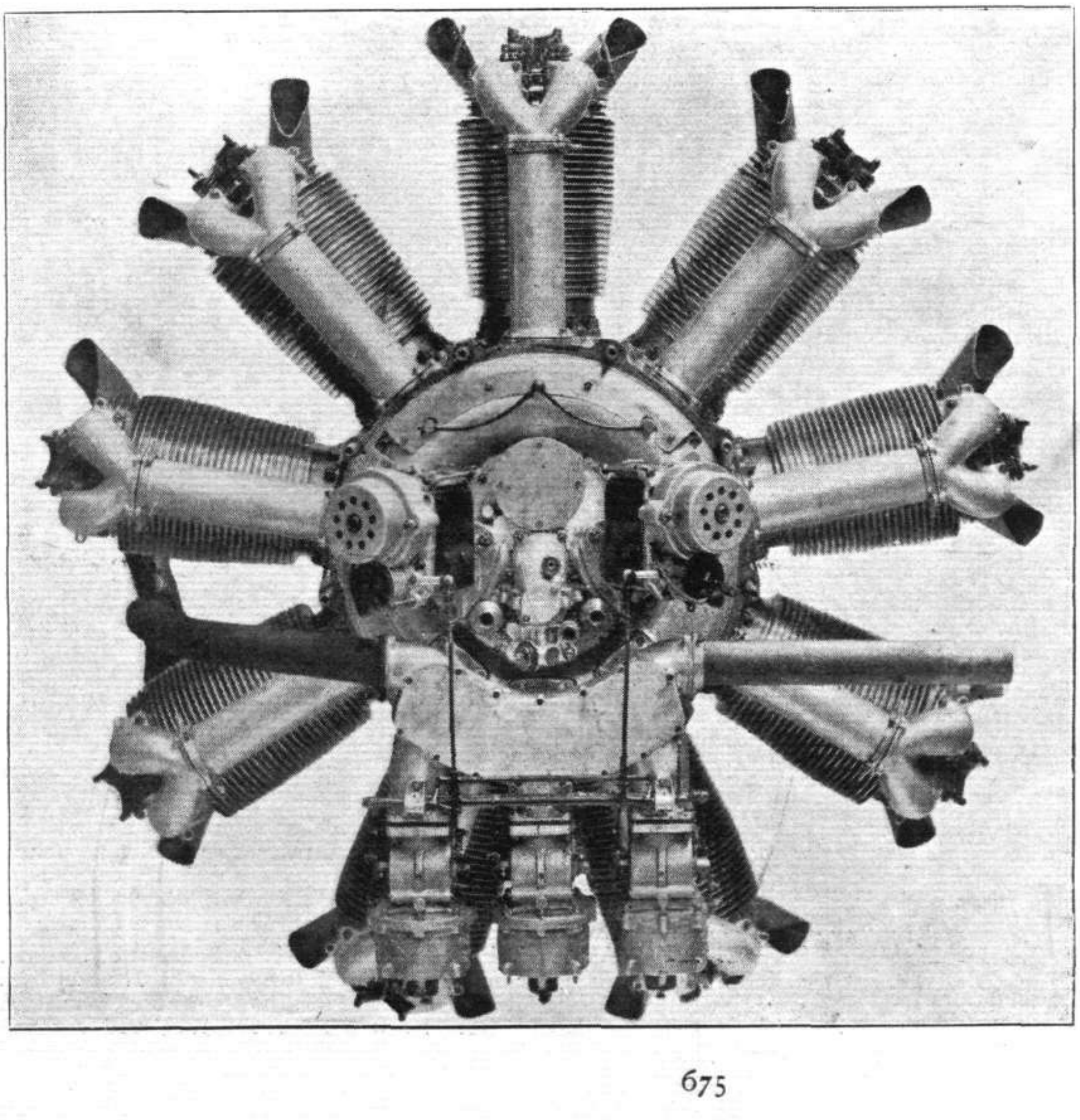
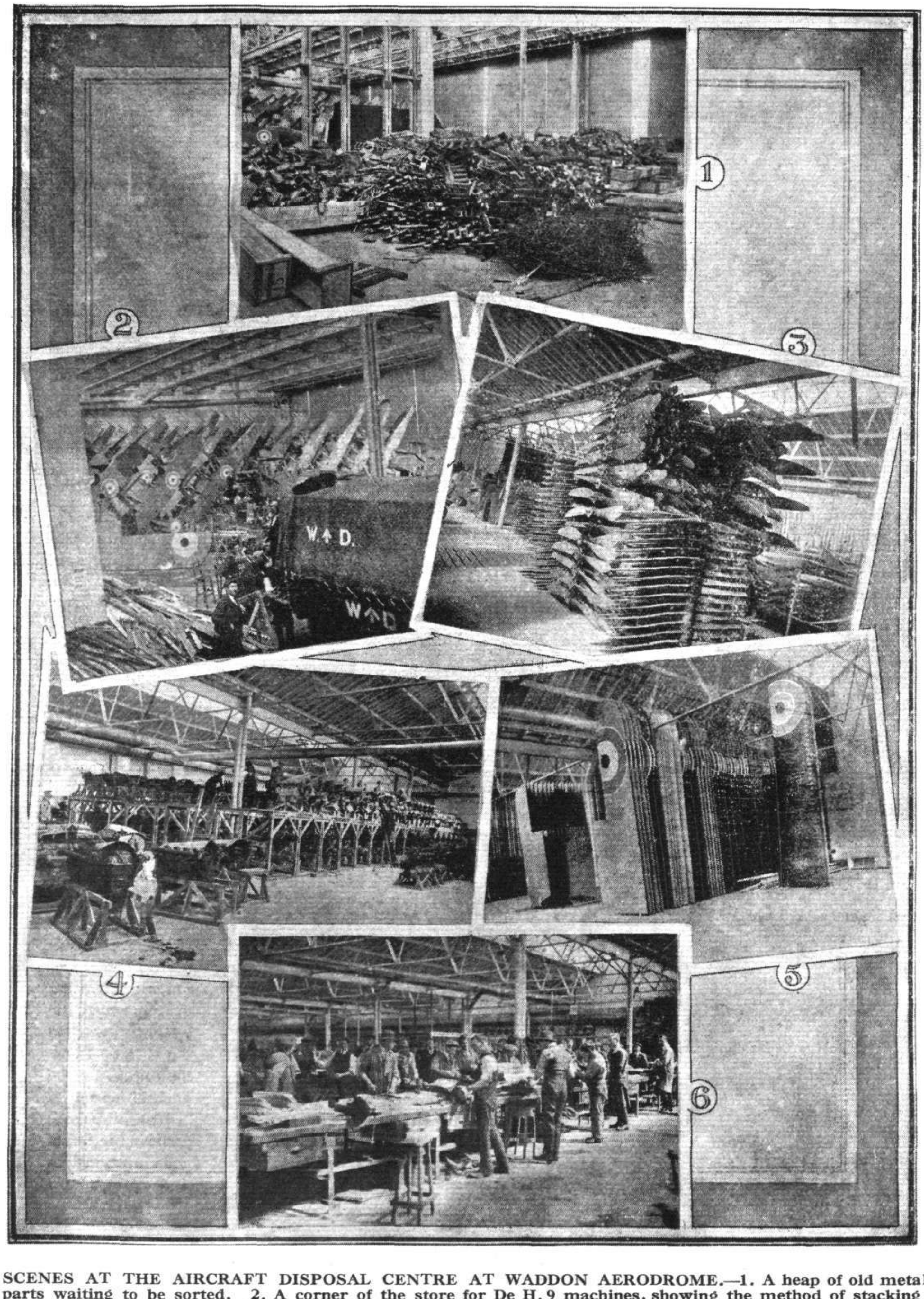
AND now what about it ?



The "Jupiter" engine: This engine, designed and built by the Cosmos Engineering Co., of Fishponds, Bristol, has recently undergone tests by the Technical Department, R.A.E., during which the weight worked out at 1.42 lbs./b.h.p. at the normal speed of 1,800 r.p.m., while the fuel consumption was .565 pint/b.h.p./hour



SCENES AT THE AIRCRAFT DISPOSAL CENTRE AT WADDON AERODROME.—1. A heap of old metal parts waiting to be sorted. 2. A corner of the store for De H. 9 machines, showing the method of stacking. 3. A few of the propellers which are available. 4. Various types of engines being cleaned up and classified. 5. The method of stacking spare wings. 6. Some of the disabled soldiers at work dissembling and sorting metal parts

"AIRCRAFT DISPOSAL"

IN spite of its uninspiring name, the Waddon Salvage Depôt is a most interesting place at the present time. Up to the time of the signing of the Armistice it was known officially as N.A.F. 1, or National Aircraft Factory No. 1, and was only just getting into its stride, producing aeroplanes. Now it is known as A.S.D. 3, and is being utilised as a centre for the disposal of surplus aircraft and material and the salvage of damaged and obsolete aeroplanes and parts.

It is such a short time since the cry on all sides was for more and more aeroplanes for the Royal Air Force that it is a little difficult to realise that one of the most acute problems facing the authorities at the present time is the disposal of its surplus machines. Down at Waddon can be seen rows and rows of aeroplanes and stacks of engines—not simply dumped down, but all carefully sorted and arranged so that they take up the minimum of room, yet leaving ample space for inspection. Great attention has been given to the question of ensuring that the machines do not deteriorate while being stored. In the case of the D.H. 9's seen in one photograph, the wheels are raised clear of the ground by wooden blocks, the weight of the *fuselage* is taken by the end of the *longerons*, and where one *fuselage* rests on another the point of contact is on a bulkhead, so that the framework cannot be distorted. This method is not suitable for all machines but in every case the principle is the same although the application may be slightly different. The wings are stored in separate racks in close proximity to the bodies, so that if anyone chooses a particular machine it can easily be got out in a very short space of time, and at the most only disturbing three machines. The same care is taken in the storing of propellers and spare wings.

In the case of the engines the process is a little different. They mostly arrive in cases and after being unpacked are mounted on a special stand, thoroughly cleaned and greased. Then they are graded as follows: "A," brand new; "B," used, but as good as new "C," secondhand but serviceable; "D," damaged or incomplete. They are then taken to the store where the various engines are grouped according to make and condition. One of our photos shows a corner of this store.

Alongside the factory is a large aerodrome, so that when a machine has been selected it can be assembled, tested and flown away.

So far we have dealt with the handling of complete machines and parts, but there is another side to the work at Waddon. It is a receiving depot for a great deal of the "junk" of the R.A.F.—crashed and damaged aeroplanes and bits thereof—and it is the job of the factory to reduce this to "produce." When the train disgorges its load of broken wood and twisted metal it appears almost hopeless to turn such chaos into order, but the system has now been so developed that in a very short time the various classes of material are sorted out.

The fabric is carefully stripped and packed up to go to another factory, where the dope is recovered and then sent on to make high-class paper, the instruments, fittings, strainers, and wires, etc., are taken to the store, and the wood-work is utilised for making the racks and engine stands in the store.s The metal is sorted out and wherever fittings are recoverable they are taken off and sent to the store. As far as possible the steel parts are classified according to the material and the non-ferrous metals go to the foundry where they are melted down. The method of dealing with damaged radiators gives one an idea of the way in which the department goes to work. First of all the radiator is placed in an oven and the solder is run off; then the soft brass shell is melted down into ingots and the hard brass tubes, in their turn, go through a similar process; and all three classes of ingots are in great demand.

A visit to the factory leaves one outstanding impression—that a serious attempt is being made to turn all this surplus material to as good account as is possible and to obtain the utmost value from it. It is also extremely satisfactory to know that practically all the work is being done by discharged sailors and soldiers; many of whom have either lost a limb in the War or suffered some disablement. There is a certain amount of female labour employed, but, here again, preference is given to the widows and dependents of those who have given their lives for their country.

From what has been said it will be gathered that Waddon presents plenty of opportunities for those who are in the market for aircraft or materials; but, in the first place, enquiries should be directed to the Aircraft Disposal Board's offices in York House, Kingsway, where samples are on view of almost everything obtainable, from complete aeroplanes to bolts and nuts. Waddon is, to all intents and purposes, a wholesale warehouse—and a wonderful place.

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German Claim for Height Record

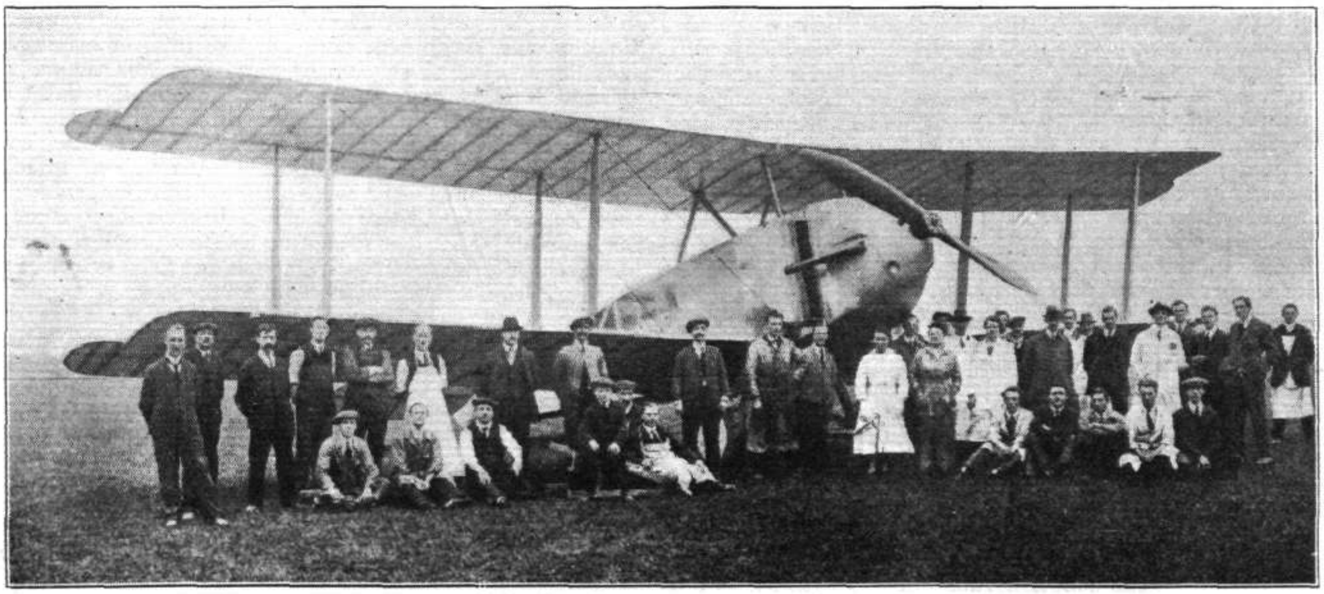
ACCORDING to a message from Basle the German Lieut. Diemer claims to have broken the altitude record by climbing to 9,200 metres (30,360 feet) in 90 mins. It is not clear whether this is claimed as a world's record, or only one for Germany, but it is stated that the flight was observed by an International Commission.

Peace Treaty by Aeroplane

LIEUT. KRAUSE, who, on May 10, flew from Paris to Copenhagen in eight hours, continued the journey two days later and arrived safely at Stockholm, although he had to come down on the way to make a slight adjustment. He had a passenger and carried mails as well as copies of the Peace Treaty for the Scandinavian Governments.

Photographing an Eclipse from an Aeroplane

PROFESSOR DAVID DODD, of Amherst College Astronomical Observatory, left New York on May 14 for Montevideo, where he proposes an ascent in an aeroplane to observe the eclipse of the sun on May 29. He proposes to go 10,000 ft. up to take photographs.



ANOTHER PHOTOGRAPH OF THE ALLIANCE-NAPIER BIPLANE: Last week we published a photograph of this machine, which has a speed of 140 m.p.h. and a range of 3,000 miles. It is fitted with a Napier Aero engine. In front of the machine are seen some of the people who have helped to build it

THE TRANSATLANTIC FLIGHT

AT the time of writing there is no definite news as to the fate of Mr. H. G. Hawker and Commander K. Mackenzie-Grieve from the time of their leaving St. John's, Newfoundland, on their Sopwith machine on Sunday evening. It is curious that no message was received from the aeroplane, and no acknowledgment was given of messages sent to it regarding the Martinsyde mishap. This silence, taken in conjuncton with the fact that the machine was not seen by any ship, would appear to indicate that the machine was in trouble before striking the trade route.

The message from the official starter states that the Sopwith Rolls-Royce biplane began the Transatlantic flight at 6.48 p.m. from Mount Pearl flying field, St. John's, Newfoundland, the machine bearing a seal on the left intersection strut, inscribed H.M. Just, O.M.S. Newfoundland. Just before crossing the coast line Mr. Hawker dropped the chassis of his machine. At 7 p.m. the signalman at the marine look-out on the hills above St. John's reported that the Sopwith had passed out of sight, in a south-easterly direction and at a height of 8,000 ft.

On the departure of the Sopwith machine Mr. Raynham prepared to start on the Martinsyde. There was a cross wind blowing at the time, but in a third attempt the machine just got off the ground, but being caught by a gust of wind it crashed. Fortunately neither Mr. Raynham nor Capt. Morgan were seriously hurt, but it will be some time before the machine can be ready for flight.

Nothing further was heard of the Sopwith machine until Monday evening, when the following message was issued :—

"The Admiralty have received the following wireless message from Castletown (Berehaven, County Cork) wireless station : 'Sopwith machine down in 52 deg. 30 mins. north, 11 degs. west. Information sent by wireless telegraph to all ships.'"

This message raised hopes, which were only to be dashed by a later message which said that further enquiries had failed to confirm the news. As far as can be gathered what happened was that a French station picked up the Admiralty message warning all ships to look out for Hawker's machine, and apparently the message was re-transmitted as if the machine was down in the position given.

As will be seen from the following official statement, the Government has sent out a number of speedy war vessels to search for the missing machine, but up to the time of writing no definite news had been obtained.

The following statement setting forth the position of the Air Ministry and the Admiralty was officially issued on Tuesday evening :—

It must be understood that these flights are being undertaken as private enterprises and are not in any sense under Government control.

As stated by the Under-Secretary of State for Air, in the House of Commons on May 8, the attitude of the Air Ministry in regard to the Transatlantic Flight has been to enjoin caution upon those engaged in the enterprise rather than to urge them on to make the attempt.

Even if it were otherwise desirable to assist this enterprise by patrolling the seas with His Majesty's ships the many and heavy obligations of the Fleet would render this impossible. Although, however, the Government cannot recognise any responsibility in this matter, every possible information has been furnished and every assistance has been given in regard to weather reports, navigation, wireless and instruments, which could make the venture less hazardous. Throughout there has been complete cooperation between the Admiralty and the Air Ministry in this matter.

So soon as it was made known some weeks ago that competitors were ready to start, a special officer, known as the Transatlantic Duty Officer, was placed on duty night and day at the Air Ministry. When news was received that Mr. Hawker had started, this officer instructed the Marconi Company to warn the wireless stations at Poldhu and requested the War Registry at the Admiralty to warn Valentia and Poldhu. This was done. The message was to the effect that all ships should be advised that Mr. Hawker had started. The type of machine, the call sign and the time of starting were given.

Last night, after consultation between the Under-Secretary for the Air and the First Sea Lord, orders were issued from the Air Ministry to the Officer Commanding, Royal Air Force Headquarters, Dublin, to get into touch with the Admiral, Queenstown, and place himself under the Admiral's orders with a view to lending assistance by means of aeroplanes in searching for Mr. Hawker, who, it was then supposed, had fallen into the sea off the coast. In accordance with these instructions orders were given for two squadrons of aeroplanes to proceed at once in search of Mr. Hawker. It was impossible for the machines to start last night owing to the rain, a gale and low clouds. This morning the machines have attempted a search, unfortunately with no result.

In addition to the steps which were taken by the Admiralty on the evening of the 19th, as described to-day in the House of Commons, the naval authorities have ordered the immediate dispatch of a number of destroyers in further search of Mr. Hawker, though in view of the vast areas involved the Admiralty are bound to warn the public that the chances of finding him are very remote.

As regards future flights, the Government, in view of comments as to responsibility in this matter, feel bound to call attention to the many and heavy obligations of the British Fleet. Those responsibilities involve duties in many parts of the world which cannot be set aside. The Admiralty have especial commitments in the Mediterranean, the Black Sea, North Russia, the Red Sea, and the Baltic—in which, indeed, there has been fighting within the last few days.

They are also responsible for the vast and continuous mine-sweeping operations. While all these things engage their attention, they are being pressed to find reliefs for men on foreign stations asking for demobilisation, and pressed also to release men everywhere who joined for the period of the war, and any addition to the duties of the Fleet could only be undertaken at the cost of delaying further demobilisation and withholding home leave from men who have served long periods of war service on foreign stations.

These things being so, while the Government is and has been most anxious to do everything it can to save such gallant and intrepid airmen as Mr. Hawker and Commander Grieve, it feels bound to warn those who may in future make the attempt to fly the Atlantic that its resources make it utterly impossible that the immense task of patrolling 2,000 miles of the ocean by way of protection can be undertaken.

With regard to the American flying boats we mentioned in our last issue that the N.C. 1 and N.C. 3 had reached Trepassy, while the N.C. 4 was delayed at Chatham, Mass., with engine trouble. The last mentioned craft was able to resume her journey on May 14, when she flew on to Halifax. The next day she flew the 550 miles to Trepassy in six hours. The American airship C. 5 arrived at St. John's on May 15, having taken 25 hrs. 40 mins. to cruise the 1,080 miles from Montauk Point, Long Island. On the trip the vessel encountered a belt of fog and rain which caused some two hours delay. Later in the afternoon the west wind increased in force and tore the airship from her mooring. An officer and four men on board made a vain attempt to deflate the airship and then jumped into the sea. The vessel drifted away and, up to the time of writing, she had not been sighted.

On May 14 the N.C. 1 and N.C. 3 made a trial flight, and it was at first reported that they had started for the Azores. After making a cruise of an hour or so, however, they returned to the harbour. They actually started on the Transatlantic flight on the evening of May 16; the time of leaving Newfoundland being 10.11 p.m. London time, and they were out of sight half an hour later. The N.C. 4, piloted by Lieut. Commander Reed, arrived at Horta, Fayal Island, Azores, at 1.25 p.m., Greenwich time on Saturday, having covered the 1,380 miles in 15 hrs. 19 mins. He reported having met good weather until within 200 miles of Corvo Island, when they began to encounter fog. The other two craft ran into fog and the N.C. 1 descended in the sea 200 miles north-west of Fayal, and was eventually picked up by the British steamer "Iona," which took off Lieut.-Commander P. L. Bellinger and his crew. The damaged seaplane was taken in tow but the tow line broke and it is doubtful whether it will be possible to salve the wreck.

The N.C. 3 also encountered heavy rainfalls and, apparently, was blown off its course. Commander Towers brought his craft down at 1.33 on Saturday to make observations, and then owing to the heavy seas parts of the machine were so damaged as to render it impossible to get into the air again. She, however, managed to taxi about 200 miles and eventually reached Ponta Delgada, Azores, at 5.50 p.m. on Monday.

The N.C. 4 on Tuesday left Horta and flew to Ponta Delgada to be in readiness for the next stage to Lisbon.

It was announced on Tuesday that Mr. Sydney Pickles, who was nominated as the pilot of the Fairey-Rolls-Royce seaplane, had decided, for domestic reasons, not to make an attempt under existing conditions.

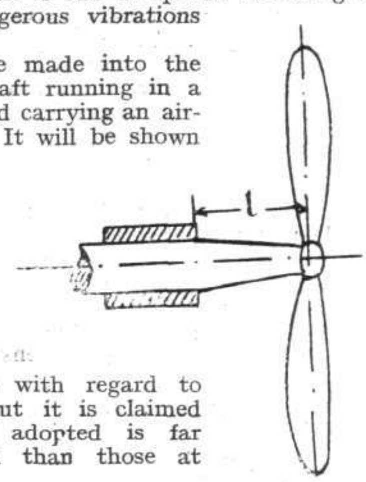
THE WHIRLING OF AN AIRSCREW SHAFT

By J. MORRIS, B.A.

1. *Introduction.*

IN designing an engine it is not only necessary to examine every possible source of failure and make due allowance accordingly, but it is also essential to reduce vibration to a minimum.

A frequent source of danger with regard to rotating shafts is due to the fact that at certain speeds dependent on the stiffness of the shaft and its loading, the shaft tends to collapse. Such a speed is called "critical" or "whirling" speed. Further, if the shaft is run at speeds bordering on the "critical" speed dangerous vibrations will be set up.



An investigation is here made into the "whirling" speed of a shaft running in a long bearing at one end and carrying an air-screw at the other end. It will be shown that the method adopted is applicable to the case of a shaft of any section (variable or otherwise).

In particular complete solutions will be given for: (1) a uniform shaft; (2) a conically tapered shaft.

The usual assumptions with regard to whirling will be made, but it is claimed that the method herein adopted is far simpler and more general than those at present in vogue.

For a strict investigation the motion should be examined when the shaft is both vibrating and rotating. That speed for which vibration is about to cease is then taken as the dangerous speed.

However, the same result will be arrived at if the shaft is considered as rotating with steady motion, and the speed found at which the displacements—lateral and angular—tend to become large.

To simplify the treatment the latter method will be adopted in the case under consideration.

2. *Notation Employed.*

W_a = Weight of the air-screw in pounds.

I'_a = Difference between the moments of inertia of W_a about the centre line of the shaft and an axis through its mass centre perpendicular to the former axis in lbs. (feet).^{2}

w = Weight in pounds of that portion of the shaft from the extreme end up to the bearing.

l = Length of the shaft in feet.

E = Young's modulus of elasticity for the material of the shaft in pounds weight per square foot.

Ω = Angular velocity of the shaft (supposed constant).

Ω_c = Angular velocity of the shaft at which whirling takes place.

N = Whirling speed in r.p.m.

Thus—

$$N = \frac{30\,\Omega_c}{\pi} \text{ or } \frac{1}{\Omega_c^2} = \frac{900}{\pi^2 N^2}$$

y_a = Deflection of the shaft in feet per lb. at the point of attachment of the air-screw due to unit load (dead weight) at that point.

Z_a = Slope in radians per lb. at that point due to the same load.
= also the deflection in feet/(lb. foot) due to unit couple (static) at that point.*

ϕ_a = Slope in radians/(lb. foot) at that point due to unit couple (static) at that point.

γ_a = Deflection at the mass centre of the air-screw due to the total loading of the shaft.

θ_a = Slope at that point due to the same loading.

$$\frac{W_a + \dfrac{w}{3}}{g} = m_a \text{ and } \frac{I'_a}{g} = p'_a,$$

Where g has its usual significance and is taken as 32 feet/sec^2.

3. *Solution of Problem.*

The shaft with air-screw attached is regarded as rotating with steady motion in a deflected position.

There will be acting at the point of attachment of the air-screw

(1) A centrifugal force—

$$\frac{\left(W_a + \dfrac{w}{3}\right)\Omega^2\gamma_a}{g} \text{ or } m_a\Omega^2\gamma_a \tag{1}$$

where to W_a has been added $\frac{1}{3}$ (weight of the shaft)—this is the correct proportion for a uniform shaft, and will be considered near enough for a non-uniform shaft.

(2) A centrifugal couple—

$$-\frac{I'_a\Omega^2\theta_a}{g} \text{ or } -p'_a\Omega^2\theta_a \tag{2}$$

$$\left.\begin{aligned} \text{Hence—}\quad \gamma_a &= m_a\Omega^2\gamma_a y_a - p'_a\Omega^2\theta_a z_a \\ \text{and—}\quad \theta_a &= m_a\Omega^2\gamma_a z_a - p'_a\Omega^2\theta_a\phi_a \end{aligned}\right\} \tag{3}$$

$$\left.\begin{aligned} \text{or—}\quad (1 - m_a y_a\Omega^2)\gamma_a + p'_a z_a\Omega^2\theta_a &= 0 \\ \text{and—}\quad -m_a z_a\Omega^2\gamma_a + (1 + p'_a\phi_a\Omega^2)\theta_a &= 0 \end{aligned}\right\} \tag{4}$$

Solving equations (4) for γ_a or θ_a we find—

$$\left[m_a p'_a(y_a\phi_a - z_a^2)\Omega^4 + (m_a y_a - p'_a\phi_a)\Omega^2 - 1\right]\begin{matrix}\gamma_a \\ \text{or} \\ \theta_a\end{matrix} = 0 \tag{5}$$

Hence either $\gamma_a = \theta_a = 0$ or

$$m_a p'_a(y_a\phi_a - z_a^2)\Omega^4 + (m_a y_a - p'_a\phi_a)\Omega^2 - 1 = 0 \tag{6}$$

Thus the critical angle of velocity answering to "whirling" will be given by the positive root of Ω^2 in (6).

Thus—

$$\frac{1}{\Omega_c^2} = \frac{m_a y_a - p'_a\phi_a + \sqrt{(m_a y_a - p'_a\phi_a)^2 + 4m_a p'_a(y_a\phi_a - z_a^2)}}{2}$$

$$\text{or } \frac{1}{\Omega_c^2} = \frac{m_a y_a - p'_a\phi_a + \sqrt{(m_a y_a + p'_a\phi_a)^2 + 4m_a p'_a z_a^2}}{2}$$

$$\text{or } \frac{1}{N^2} = \frac{\pi^2[m_a y_a - p'_a\phi_a + \sqrt{(m_a y_a + p'_a\phi_a)^2 + 4m_a p'_a z_a^2}]}{1800} \tag{7}$$

This formula will give the critical speed in r.p.m. when—
y_a, z_a, ϕ_a are known.

For a uniform shaft—

$$y_a = \frac{4l^3}{3\pi E r^4},\ z_a = \frac{2l^2}{\pi E r^4} \text{ and } \phi_a = \frac{4l}{\pi E r^4} \tag{8}$$

where r is the radius of the cross section.

For a conically tapered shaft—

$$y_a = \frac{4l^3}{3\pi E r_a r_o^3},\ z_a = \frac{4l^2(r_o + 2r_a)}{6\pi E r_a^2 r_o^3} \text{ and } \phi_a = \frac{4l(r_o^2 + r_o r_a + r_a^2)}{3\pi E r_o^3 r_a^3} \tag{9}$$

where r_o is the radius at the bearing and r_a the radius at the air-screw.

Hence, given the requisite dimensions, we can calculate y_a, z_a and ϕ_a from the expressions (8) or (9) according as the shaft is uniform in section or conically tapered. We next insert these values in the formula—

$$\frac{1}{N^2} = \frac{\pi^2\left[\left(W_a + \dfrac{w}{3}\right)y_a - I'_a\phi_a + \sqrt{\left\{\left(W_a + \dfrac{w}{3}\right)y_a + I'_a\phi_a\right\}^2 + 4\left(W_a + \dfrac{w}{3}\right)I'_a z_a^2}\right]}{1800g}$$

and we have the required value of N answering to whirling.

In a shaft for which y_a, z_a, ϕ_a cannot be calculated simply they can be found by direct experiment.

For example, if a static load of W lbs. placed at the point of attachment of the air-screw produces a deflection of γ_w inches and a slope θ_w degrees at that point—

$$y_a = \frac{\gamma_w}{12W} \text{ and } z_a = \frac{\pi\theta_w}{180W}$$

Similarly, if a static couple G lbs.-feet applied at the same point produces a deflection of γ_G inches, and a slope θ_G degrees at that point—

$$z_a = \frac{\gamma_G}{12G} \text{ and } \phi_a = \frac{\pi\theta_G}{180G}$$

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* This follows from the following reciprocal relation due to Lord Rayleigh. (See *Phil. Mag.*, xlviii, pp. 452–436, 1874, and xlix, pp. 183–185, 1875):—

"For a rod (not necessarily uniform in section) if P and Q be two points on it:—A couple at P would do as much work in acting over the rotation at P due to a simple force at Q as the force at Q would do in acting over the displacement at Q due to the couple at P."

METAL CONSTRUCTION OF AIRCRAFT*

BY A. P. THURSTON, D.SC., F.R.AE.S., F.R.MET.S., M.I.A.E.

[One of the most interesting and instructive lectures given at the Royal Aeronautical Society for a considerable period was that under the above title delivered by Dr. Thurston on Wednesday of last week. Dr. Thurston, who had just got out of hospital after a very severe illness, is still very far from being strong, and it was evident that it was only by exerting a great amount of will-power that the lecturer was able to get through the reading of what proved to be a very long paper. However, his efforts had their reward, not only in the size, but also in the quality of the audience, which was one of the largest seen at the Royal Society of Arts for a long time, and which included representatives of most of the leading aircraft firms, as well as a number of representatives of the Sheffield district. The paper appears to us to be of such great interest that we have decided to publish it in full. Owing to lack of space it has not been possible to print the entire paper in this issue, and further instalments will, therefore, follow.—ED.].

THE War has been fought with machines made of wood, a most unsatisfactory material from a constructional point of view. Wood warps and cracks; is unsuitable for tropical climates; splinters easily in a crash; is liable to transfix the aviators; is non-homogeneous; uncertain in strength and weight; weakens rapidly when exposed to moisture, and is not produced in any quantity in this country.

On the other hand metal does not splinter; it is much safer in a crash, the members hanging together and forming a shield to protect the aviators; its properties are known to a fine degree and may be relied upon; it can be produced in immense quantities, and, moreover, metal members, after breaking, can still carry a considerable load. Many lives have already been saved by the use of metal bodies.

A year ago over 1,000 all-metal machines had been used with success in the allied fighting line, but not one had been made in this country. Had the war extended into this year, however, a prodigious number of machines, made of steel and duralumin, exquisitely designed for their functions, would have been produced, to swamp the enemy beyond all hope—so great are our still undeveloped resources. The armistice stopped this.

It will probably take ten or more years now before meta-construction will have reached the stage of development that it would have reached in ten months under war conditions. It is hoped by drawing public attention to the problem, and by placing information at the disposal of firms interested, to hasten the development of this important industry. Our future as a nation depends so much upon our position in the air that we cannot afford to neglect so important a subject. Ultimately all our large machines will be of metal, and it is thought that no aeronautical firm can afford to neglect metal construction.

Heretofore the problem has been tackled by manufacturers largely from patriotic reasons. It is a pleasure to pay a tribute to the patriotism and energy which these enterprising manufacturers brought into the struggle. Almost without exception there has been no dog in the manger business in their policy. In many cases they have passed on generously exclusive information and trade secrets to hated rivals in order to assist them to beat the common enemy. That is the spirit to carry into peace conditions. While our manul facturers are animated by that spirit we have little to fear from foreign competition, provided always that this spirit is fostered and encouraged by wise and unselfish Government officials.

With regard to metal construction of aircraft, it may be argued that metal is too heavy to be used to construct efficient flying machines. The same argument was used in the early days of iron vessels; now wood is used only to construct small craft, and all large vessels are constructed of steel. It will be shown later that steel and duralumin are stronger than wood, weight for weight, and that the vital members of our flying machines can be, and have been, made lighter and stronger in metal than in wood. As a matter of fact the strongest flying machine yet made by any Power, and loaded until broken, is a metal Avro machine constructed by Messrs. Vickers, and this machine is lighter than the standard wooden machine.

The advantages of metal construction are not confined to greater strength, lightness, reliability and ultimate cheapness. Its use will enable many new developments to be made in the actual design of aircraft. Thus, flying machines with variable camber wings will have great advantages for commercial purposes over the common design, in that these machines may be landed at a slower speed than any other type. Those who have had much experience of cross-country work and forced landings will appreciate this. Many attempts have been made to construct variable camber machines, and these machines have been successfully flown. Some of the greatest constructional difficulties encountered will be obviated by adopting metal construction.

It was the author's intention when he took up the subject to deal fully with the whole problem, including methods of calculation. He soon found, however, that he would be compelled, from considerations of time alone to limit his paper to a small portion of the subject.

The design of aircraft resolves itself into two more or less distinct problems, namely, the aerodynamical and the structural design. The aerodynamical design comprises the determination of the right areas, shapes and dispositions of the various serfaces to obtain the best performances with the required loads and horse-power available—the structural design consists in providing members to carry the loads on the various surfaces with the required factor of safety. The most efficient structural design is one in which the required strength is obtained with the minimum weight of structure and the maximum ease and cheapness of production. Further requirements of an efficient design are durability under varied weather conditions, ease of repair and safety in a crash.

Heretofore, with a few notable exceptions, the vital members of the aircraft structure have been made of wood. The weight and strength of specimens from the same species of wood differ greatly. Spars for one type of machine were found to vary in weight from 6½ lb. to 16 lb., and the strength varied in practically the same proportion. In addition, the strength decreases with the amount of moisture absorbed. Thus, the strength of spruce in compression decreases 230 lb. per sq. in. per 1 per cent. of moisture between 10 per cent. and 25 per cent. moisture. Wooden machines sand tested under the very favourable conditions of a dry workshop therefore showed a much greater strength than in the field. A sodden machine in the tropics may have only half the strength of the same machine when tested in the workshop at home. Moreover, owing to the disposition of wood to warp or split, particularly under tropical conditions, a wooden machine quickly gets out of truth and requires trueing up. Wooden wings deflect a great deal under load, thus making it impossible to keep all portions at an efficient angle of incidence. For instance, in a single bay wooden machine under load it was found that the angle of incidence changed 1° under the struts, while in the middle of the bay the angle of incidence changed 2½ per cent. As this machine flew with an angle of incidence of not more than 1° it follows that some parts of the wing were lifting much more than other parts; moreover, the maximum loads were applied in the least favourable place, namely, in the middle of the bay.

From these considerations it follows that there is a strong argument in favour of metal construction if it can be efficiently and cheaply utilised.

We are an engineering nation with vast mineral resources, and practically no timber, and our knowledge of high-grade steels is superior to that of any other nation.

It is, therefore, sound policy, in view of the vital importance of aeronautics to our safety as a nation, that we should spend large sums in developing metal aircraft. At no distant date we may expect to see flying machines of not less than 100,000 to 200,000 lbs. and metal is the only substance from which such machines can be satisfactorily constructed. Metal machines have now been thoroughly tested in the air. They have been spun, rolled and looped and sand tested.

Basic Principles.

The metals which are immediately available for metal construction are steel and duralumin, other alloys should be available shortly.

The specific gravity of good dry spruce, grade A	= .45.
The specific gravity of steel	= 7.8.
The specific gravity of duralumin	= 2.8.
Young's modulus in bending for all steels approx.	= 13,600 tons sq. in.
Young's modulus in bending for duralumin	= 5,500 ,, ,,
Young's modulus in bending for spruce, A approx.	= 715 ,, ,,

The modulus is, of course, less in tension.

Hence, steel is 17 times heavier than good spruce and duralumin is six times heavier than good spruce.

The strength of spruce in combined bending and end load cannot be assumed greater than 5,500 lbs. sq. in. or 2.45 tons sq. in, the pure bending test should never be used for wood.

* Paper read before the Royal Aeronautical Society at the Royal Society of Arts, John Street, Adelphi, Strand, W.C., on Wednesday, May 14th, 1919.

It follows that grave errors resulted during the war owing to pure bending tests only being used.

Steel of 42 tons per sq. in. or duralumin of 15 tons per sq. in. are equal in pure bending, weight for weight, to grade A spruce, providing the full strength of the material can be developed.

The strength of a long strut or spar under combined bending and end load is governed by the modulus of elasticity.

The strength of a long strut with free ends being given by Euler's formula $\pi^2 EI/l^2$.

It follows that steel struts are, weight for weight, 1.1 times as strong as spruce, and that duralumin struts are 1.2 times as strong as spruce, provided the full strength of the metal is developed. These figures relate to the best wood obtainable under peace conditions, but they are much more favourable to metal when compared with wood available under war conditions.

Thus, the specific gravity of dry Oregon pine or Douglas spruce, which we have been compelled to use in large quantities, is 0.51.

The transverse strength or bending strength of grade B timber is 4,500 lbs. per sq. in. or 2 tons per sq. in.

The modus of elasticity of grade B timber is 625 tons per sq. in.

Therefore steel is 15 times heavier than grade B Oregon pine, and duralumin is $5\frac{1}{2}$ times heavier than grade B Oregon pine. Hence, steel of 30 tons per square in. or duralumin of 11 tons per square in. are equal, weight for weight, in pure bending to grade B Oregon pine, provided the full strength of the material can be developed. Further, steel struts are, weight for weight, 1.4 times as strong as grade B Oregon pine, and duralumin struts are 1.6 times as strong as grade B Oregon pine. Moreover, since the deflection of a beam under load is proportional to the modulus of elasticity and the end load in a beam introduces an additional bending moment equal to the product of end load and deflection it follows that the above figures are capable of being improved upon, provided always that such a design can be obtained and that the full strength of metal can be developed.

Metal construction has the further advantage that the metal may be disposed at a greater average distance from the neutral axis.

It may be argued, since the modulus of elasticity of all grades of steel is approximately the same, that the grade of steel to be used in struts is of no importance. This is not so in fact, because with mild steels small local damage causes local failure, whereas with higher grade steel local damage is of minor importance.

Local Failure.

The metal used in the construction of metal aeroplanes must be extremely thin if it is to compete in weight with wood. The most useful thicknesses for steel have been found to be .015 in., 0.18 in. and .022 in.

Duralumin has the advantage over steel in that it is three times thicker, weight for weight. The chief difficulty with thin metal structures is local failure due to local flexure before the full strength of the material has been developed.

A preliminary series of tests were made by Major Wylie on square tubes having flat sides $1\frac{3}{8}$ in. wide which were 50 times the thickness of the metal. The tube was heat treated so as to raise the elastic limit of the material to above 80 tons per square inch, but when tested by bending, the side in compression formed transverse corrugations at a stress of 25 tons per square inch, and these corrugations increasedwith increasing load, and finally caused failure at a stress of about 40 tons per square inch.

When tested in compression the tube failed completely at about 25 tons per square inch as soon as the corrugations appeared.

Further tests on circular tubes of the same thickness and of diameters varying from $1\frac{3}{8}$ ins. up to over 2 ins. were also made, and in all cases the circular tubes developed the full strength of the material. A $1\frac{3}{8}$ in. × 22 gauge tube did not collapse until a stress of over 110 tons per square inch had been reached, and then failed suddenly at a slight dent. A tube having a diameter of over 2 in. and a thickness of .01 of its diameter, which is considerably less than 22 gauge, did not fail until a stress of 100 tons per square inch had been reached, and then failed in tension. It is evident, therefore, that curved surfaces must be used instead of flat surfaces.

From tests which have been made it appears that the radius of curvature should never be more than 20 times the thickness of the metal. This is unlikely to put any limitation on good design and will ensure the section standing up to the maximum strength of the material without failing, and make it capable of taking a fair amount of punishment from local damage.

A series of designs of spars and struts in which the principle of longitudinal corrugation has been applied will be shown later.

Before proceeding to consider these designs, it is desirable to set forth particulars of the materials of construction available.

Materials. Steel Strip.

Thin steel strip is produced by cold rolling, as it is not economical to roll material in the hot state to less than 17 or 18 gauge.

The hot rolled strip is usually first pickled and then cold rolled to the thickness desired. As the metal is reduced in thickness it is hardened, and the tensile strength and yield point increased, and a point may be reached where the hardness is so great that it must be removed by annealing before further reduction can be made.

With a .3 carbon steel a reduction of more than 40 per cent. by cold rolling after annealing makes the strip too brittle. A ·1 per cent. carbon steel may be reduced to a quarter its thickness before annealing is necessary, whereas a ·8 per cent. carbon steel can only be given a slight reduction in thickness without annealing. This makes the process of cold rolling costly and laborious—.3 per cent. to .4 per cent. carbon steel appears therefore to be the most suitable quality in which to obtain large output with good strength.

By cold rolling a .3 to .35 carbon steel the tensile strength and yield point may be increased up to about 65 tons per square inch with practically no ductility. This renders the strip unsuitable for rolling into suitable sections.

If, however, the strip is tempered or "blued" for 15 or 20 mins, at any temperature between 0° and 450° C., the ductility may be increased to any desired amount according to the temperature, and the maximum breaking stress and yield point do not fall to that of the original. cold worked figures until a temperature of 425° to 450° C. is reached.

Usually blueing for 20 minutes at 400° to 450° can be relied on to increase the ultimate and yield strength by 5 tons per square inch and the elongation from practically nothing to about 7 per cent.

This is a remarkable property of steel which was first discovered in connection with tubes and afterwards applied to steel strip.

One process of manufacture is therefore by cold rolling and "blueing" simple carbon steels. The process of rolling develops a grain in the material which cannot be removed even by complete annealing ; steel strip is therefore unsuitable for bending or rolling into sharp angles and all strip steel designs should be formed of easy and continuous curves or corrugations. This is a second reason for longitudinal corrugations in design.

A second process of manufacturing steel strip is by continuous quenching and annealing low and medium carbon steel strip. The response to this form of heat treatment is very much greater in thin strip than in ordinary sections. There are several modifications of this process. In one process the steel strip passes continuously through a furnace, and the red hot strip is quenched by running through an oil bath. The quenched strip then runs through a lead bath and is tempered. In another process it is quenched by running between cast iron or steel dies through which water is circulating and is afterwards tempered in a gas furnace. In both the oil quenching and lead tempering process and the die hardening and gas tempering process care must be taken to cool the strip after being tempered before winding on a coil, otherwise the heat accumulated and the strength and ductility of the strip at different ends of the coil varies considerably. Some of the best results have been obtained with rejected corset steel. A coil of steel containing about .32 per cent. carbon, oil quenched, hardened outright and tempered at 200° C., had a strength of 115 tons per square inch with quite moderately good ductility, while after tempering at 250° the strength was 110 tons per square inch, the yield 90 tons per square inch, and the ductility was sufficient when bent along the grain to enable it to be rolled into a standard corrugated flange. Further tempering of this same strip at 450° C. reduced the strength to about 70 tons ultimate and 65 tons yield, and induced sufficient ductility in the material to enable it to be flattened on itself either way of the grain so that this metal was quite capable of withstanding being pressed into ribs.

The effects of cold rolling, blueing, quenching and tempering similar steels to the above is set forth in an interesting monograph, Appendix I., contributed by Messrs. Arthur Lee and Sons, Ltd.

The third process, which has yielded excellent results, has been developed by Messrs. Kayser, Ellison and Co., Ltd. This process consists in hardening and tempering by a special process alloy steel strip. The resulting product is scoured

by a special process and can be welded, punched, rolled and bent longitudinally and laterally without further heat treatment.

This steel should be tempered either below 150° C. or above 450° C. if durability and capacity to resist shock and vibration are required. This remarkable phenomenon is set forth in the interesting monograph, Appendix II., by Mr. Henshaw, of Kayser, Ellison. Between these temperatures the Izod impact test gives a low figure. Further properties of this type of steel are set forth in Mr. Mackinder's monograph, Appendix III. It is a pleasure to pay a tribute to the patriotic way in which Mr. Kayser, of Kayser, Ellison and Co., Ltd., together with the associated firms of Arthur Lee and Co., Ltd., and the Effingham Steel Co. and other manufacturers of Sheffield and district have tackled and solved successfully the problem of the evolution of metal strip suitable for aircraft construction.

The strength of metal constructions appears to be governed more by the yield point than by the ultimate strength, hence attention should be paid to obtaining a good yield point. Straight steel strip can now be obtained up to 5 in. wide, having yield points of 100 tons, 80 tons, 60 tons or 40 tons.

as 500° C. is not exceeded, in which case there is danger of the metal being burnt and reduced to aluminium.

The parts should be left in the bath long enough to be heated uniformly to the temperature of the bath, the actual times allowed being five minutes in the case of small units up to several hours in the case of 3 in. bar. There is no danger in leaving it in the bath too long, providing the actual temperature of 500° is not exceeded.

At the end of this time the article is removed from the bath and quenched out in water or non-acid oil.

Immediately after heat treatment the metal is found to be in a very soft and plastic condition, and it may be pressed, forged, bent to the smallest radius, or in the case of drawn sections which have warped with the quenching, straightened without any fear of damaging the metal. The metal now commences of itself to harden up, and in about an hour's time has reached about 26 tons tensile strength, with an elongation of about 15 per cent.

This process of hardening continues for a very long period, the strength slightly increasing at the expense of the elongation.

Heating duralumin to 300° C. and then quenching out

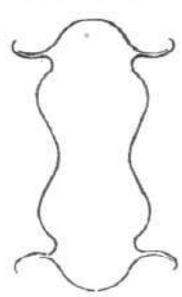


Fig 1.

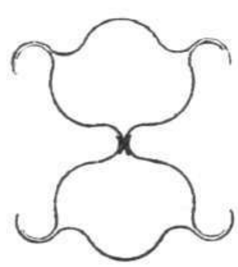


Fig. 2.

Fig. 3.

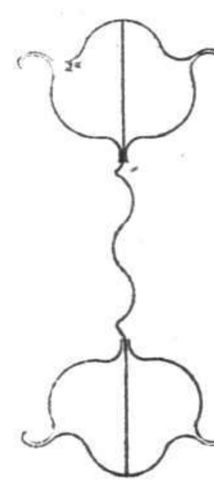


Fig. 4.

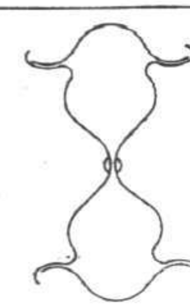


Fig. 5.

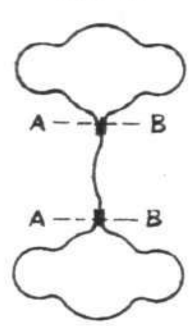


Fig. 6.

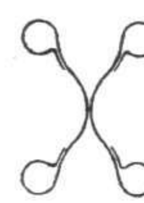


Fig. 7.

In ordering strip care should be taken to order the exact width required, since the process of splitting the strip invariably gives it a curve which can only be corrected by additional heat treatment.

Duralumin.

The second material available for metal construction is duralumin. This has many advantages over steel and a few disadvantages. Duralumin being three times lighter than steel it follows that the various members may be, weight for weight, three times thicker than steel members. Hence the difficulty in overcoming local failure due to local flexure is greatly reduced. Nevertheless, the perfection of a design can only be discovered by constructing it in steel, and it is thought that duralumin designs will be improved by adopting the principles which have proved to be the only feasible ones in steel construction.

A prejudice appears to exist in certain quarters against duralumin owing to the fear of corrosion. It should be stated that duralumin, unlike aluminium, is not acted upon by sea water, or affected by atmospheric influences, and experience in connection with airship work shows that duralumin, if properly varnished, is not affected by corrosion under ordinary conditions of service.

Nearly every case of corrosion so far experienced in actual practice has been traced back to incorrect heat treatment, or to cold working after heat treatment.

The heat treatment of duralumin instead of being a disadvantage, as is often supposed, is in actual point of fact of the greatest assistance in the practical working of the metal. This heat treatment is carried out by placing the member to be treated in a bath containing a mixture of potassium and sodium nitrates heated to a temperature of 480° C. In practice there is a fairly wide margin of temperature so long

anneals the metal, and it can then be worked in any way desired. In order to give it back its strength it is necessary to heat treat it at 480° C., as explained above.

In practice it is usual to anneal any duralumin part if a number of operations have to be performed, and on the other hand to heat treat before final operation if this is not of too prolonged a nature, taking advantage of its abnormal condition immediately after heat treatment.

An actual example of the value of this property of duralumin in slowly hardening up after heat treatment occurs when duralumin is used for rivets. If an attempt were made to rivet these up in the ordinary hard condition they would crack badly. By heat treating them, however, and using them immediately after this, a perfect job may be made while they are soft, and within a very short time afterwards they have hardened up to their full strength.

If duralumin in the ordinary hard condition is bent to a small radius, there is, as would be expected, a probability of incipient cracks developing on the surface of the metal at the bend. These cracks are the places where the corrosion begins. If the metal was properly heat treated before such bending, no injury would be caused to the surface of the metal, and no trouble would be experienced from corrosion. Nearly the whole of the prejudice against the use of duralumin is due to ignorance as to its properties with and without heat treatment. Sections cannot conveniently be drawn thicker than .2 in. Above this thickness the sections are extruded. It is advisable to use only solid drawn sections for constructional purposes and designs should accordingly be modified to meet the limitations in the material.

Constructional Designs.

Having now described some of the properties of the materials available for metal construction it remains to

describe methods of utilising these materials in an efficient and practical way. The structure of an aeroplane may be divided into two main portions: (*a*) the vital members, such as spars, struts, *longerons* and lift wires, and (*b*) the members giving form or bulk, such as ribs, *ailerons*, elevators, &c. The latter members are not stressed to the maximum limit in the same way as the vital members, and present no great difficulty in competing with wood. Thus, metal ailerons have been made and tested which were 40 per cent. lighter and 60 per cent. stronger than the wooden ailerons they were designed to replace. Improvements in design are to be looked for only in increasing the cheapness of manufacture.

With regard to the vital members the problem is far different, and here all our ingenuity and knowledge is required.

Metal designs are required for three main types of machine: (*a*) small machines up to 3,000 lb.; (*b*) intermediate machines from 10,000 to 15,000 lb.; and (*c*) large machines of from 30,000 to 200,000 lb.

The largest members in a machine are the wing spars, and these present the greatest difficulties in construction—the next largest members are the struts. As it is impossible to deal with the whole vast problem of metal construction in one paper it is proposed to limit the description to these members for the above types.

Rudge Spars.

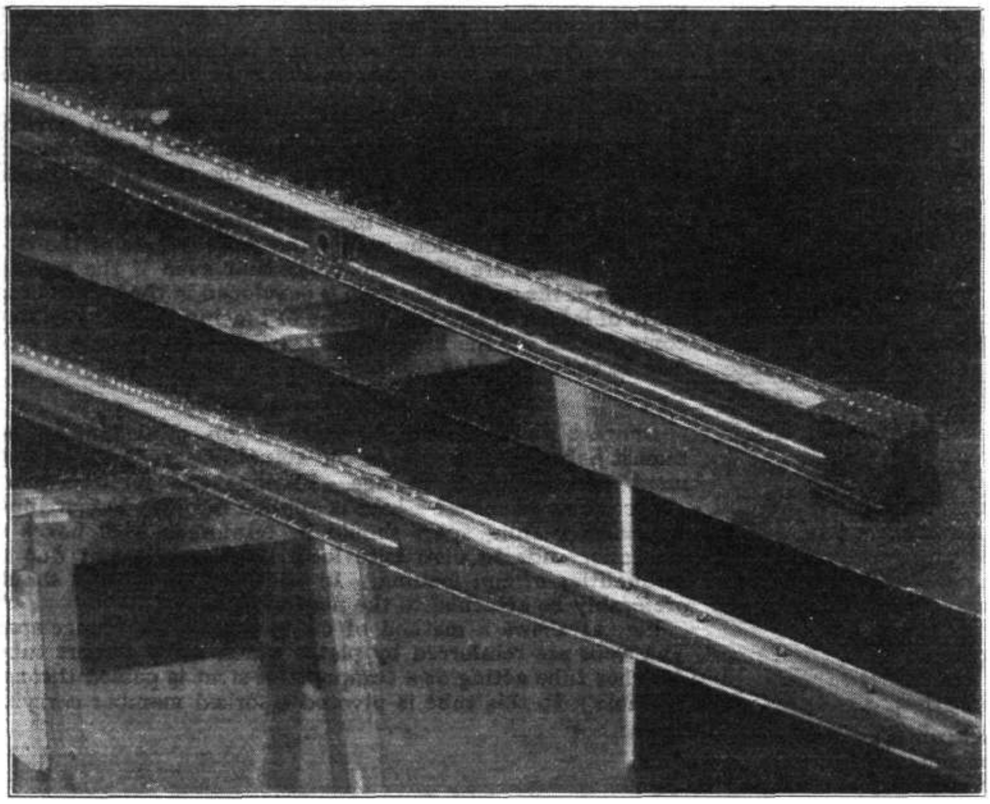
A section of the Rudge spar, developed from designs courteously placed at the firm's disposal by Lieut. Commander H. Wylie, and suitable for the Avro machine, is shown in Fig. 1.

In this spar an effective strength of 80 tons per square inch in the strut is utilised. To meet the weight requirements the thickness of the flange strip is reduced to 1 per cent. of its width, while the thickness of the web strip is reduced to ½ per cent. of its width. To prevent local failure the strips have been formed into longitudinal corrugations, the radius of each corrugation being from 30 to 100 times the thickness of the metal, a smaller radius being used when the highest compressive stresses are to be withstood. These corrugations are so effective that the Rudge spar shown has developed a compressive stress of 83 tons per square inch in the flange, while the webs have remained intact under a shear stress of about 30 tons per square inch.

When tested at the Royal Aircraft Establishment it was found that this spar is 10 per cent. lighter and 5 per cent. stronger than the wooden spar it was designed to replace.

Fig. 2 shows a modification of the Rudge spar for intermediate type machines.

The first step is to deepen the central corrugations in the webs so that they meet together, thus forming the section into tubular units. Each web is formed of two pieces joined together at the neutral line. This is necessary in view of the limited width of strip available. The free ends of the flange are turned inwards so that the maximum stress is not developed at the free edge. This considerably increases the strength of the flange.



Figs. 8 and 9.—Photographs of Rudge spars showing respectively how the spar is tapered towards the tip and how it is reinforced at the root

The best disposition of the free ends of the strip constitutes one of the problems of metal construction.

The solution lies in placing the free ends in position where they will be stressed as little as possible. Failing this they must be locally supported or strengthened if the full strength of the metal is to be developed without local failure. The Huns solved this difficulty very well with their Zeppelin bracing.

They stamped the diagonal bracing members to the section shown in Fig. 3. Thus, the free ends AB were on the neutral line and were not stressed when the member was in compression as a strut.

Fig. 4 shows a modification of the Rudge spar for a larger machine of the intermediate type or a small machine of the large type.

With this type of spar the metal must be increased in thickness to retain sufficient stability. These derived sections are obviously weak about the waist and support must be given by cross frames, or formers, which suitably occur at each rib. With the addition of these frames the section is made stiff in all directions even when the strip composing it is of extreme thinness relative to its width. The flanges are supported in the middle by extending the web into contact with the inner surface.

Fig. 5 shows a modification of Fig. 1. The depth of the spar may be readily altered by varying the depth of the central corrugations of the webs, the minimum depth being obtained where the corrugations meet in the centre. In the event of the corrugations not meeting, as in Fig. 5, it is necessary to join the webs together at intervals by a cross tubular member riveted to each.

The above designs are adapted to be riveted together either by hand or by machine.

Dunlop Spars.

Several designs have been adopted to utilise spot or strip welding—this dispenses with the difficult, and at present somewhat expensive, process of riveting.

One such design, known as the Dunlop single spar, is shown in Fig. 6.

Three coils of strip of the required width are mounted on the rolling machine. After passing through the banks of rolls each strip emerges of the required shape and passes

through guides which hold the strips while they are passed between two pairs of copper discs at A and B, which are the terminals of an electric circuit. A powerful current then passes from one disc to the other through the steel strip. The resistance offered by the strip to the passage of this current is sufficient to raise the strip to a melting temperature. After leaving the discs the ends of the strip are firmly incorporated together at the points AB. The spar emerges complete from the machine at the rate of 9 ft. per min.

This spar is almost the same in section as Fig. 4 except that each tubular unit is rolled from one strip instead of

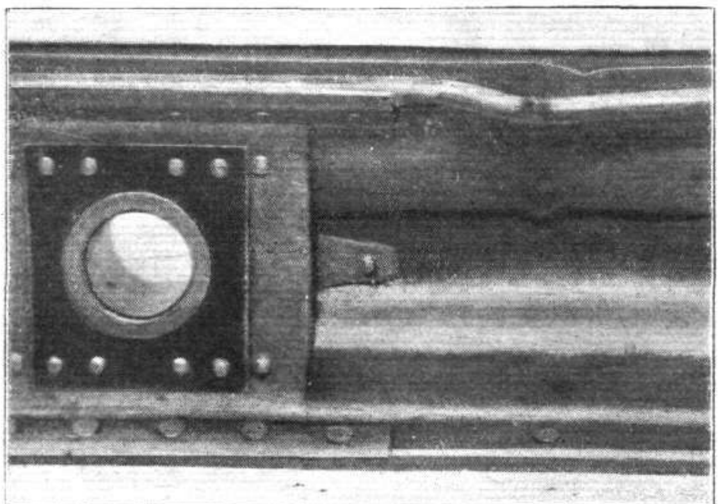


Fig. 10.

being built up from three strips. This feature is advantageous in many ways, but limits the size of the tubular unit to about two inches wide on account of the difficulty of obtaining and working up high tensile strips wider than about six inches.

One great advantage of the Dunlop type of boom is the absence of the projecting ledges provided on the previous spars for connecting the component strips together. These ledges are liable to buckle when high longitudinal compression stresses are developed in them, even if they be curved throughout and rolled round on the edges as shown in the illustrations.

Fig. 7 illustrates a section known as the double Dunlop spar. The edges of two strips are rolled into tubes and strip welded, the intermediate portions of the strip being longitudinally corrugated. The formed strips are placed back to back and connected together by spot welding. This spar is in effect two bicycle rims placed back to back and connected together at the centre. Similarly to the Dunlop single spar it requires to be supported by frames or formers at intervals to prevent the individual booms from bending as struts transverse to the web. The formers may conveniently be introduced at each rib. It has been found from tests that the distance between frames or formers should not exceed 60 times the radius of gyration of the booms. Hence, for this spar the booms require to be about one inch wide.

This spar can be made as light as .5 lbs. per foot run and develops the same strength as a wooden spar of from .65 to .85 lbs. per foot run. This type of construction is the cheapest and simplest yet developed.

In the spar designs shown the strips run continuously throughout, no holes being cut to lighten the sections. This continuity is a feature and has great advantages, for it has been found in tests that destroying the continuity weakens the spar considerably. Lightness can be obtained with less sacrifice of strength by reducing the thickness and increasing the curvature of sections. From experience it would appear that spars with continuous webs can be made as light as with any system of trussing, and for a given weight will be considerably stronger and more rigid.

A second feature in these designs is the absence of rivets and other means of connection along the lines of maximum stress.

In the Rudge spar, for instance, the maximum possible tensile stress along the line of rivets is about 85 per cent. of the maximum stress in the flange. In the case of the Dunlop spars it is much less.

A third and perhaps the most important feature is that all the metal in the section, except the cross frames of the ribs, is taking its share of the load, so that even if the average stress over the area is less than is developed in the longitudinal parts of lattice spars, the absence of bracing pieces more than compensates for the lower failing stress of the flanges. Figs. 8 to 10 shew a Rudge spar.

Methods of Attaching Fittings

Another problem of metal construction, presenting in fact almost as much difficulty as the actual design, is the attachment and design of fittings. Fittings and reinforcements are required whenever a load is applied in order to distribute that load. Thus, spars should be reinforced with boxes at the inner ends to distribute local bending moment due to inequalities of end loading. In addition, all fittings should preferably be attached to the neutral line.

Fig. 11 shews a method of doing this for the Rudge spar. The webs are reinforced by plates which carry a short tube. Another tube acting as a compression strut is passed through the hole; to this tube is pivoted a forked member carrying

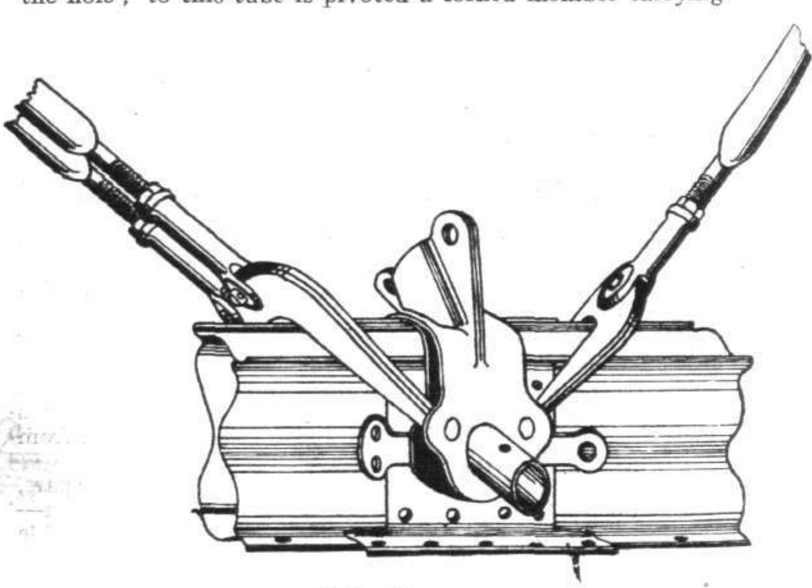


Fig. 11.

the strut, and links for the lift and anti-lift wires. By this means all the forces cut one another on the neutral line of the spar, thus avoiding offset bending moments and simplifying the calculations of the strength of this structure.

(*To be continued.*)

"The Chronicles of 55 Squadron R.F.C., R.A.F."

UNDER the above title Capt. L. Miller, writing from H.Q., R.A.F., Cologne, informs us of the publication shortly, for private circulation, of the history of 55 Squadron during the War. There must be many who would be glad to know of this little book, and as there are a certain number of copies available for ex-members of the Squadron and others interested in the Squadron, they should without delay get into communication with Capt. Miller. The price is 10s. per copy, and any surplus of profits goes to a R.A.F. charity. Procrastination means, in all probability, being without this valuable little historical and personal record.

From Turin to London

A THREE-ENGINED Caproni aeroplane, carrying a crew of eight, landed at Kenley (Croydon) at 1.10 p.m. on Monday. It had left Turin in the morning.

A Glasgow-London Trip

ANOTHER fine performance by the four-engined Handley Page was a trip from Glasgow to London on Saturday last. Piloted by Mr. C. B. Prodger, and carrying four passengers, the machine left Glasgow at 2.30 p.m., and flying over Berwick, Newcastle, Durham, York, Doncaster, and Peterborough, reached Hendon a few minutes after nine o'clock, a distance of 515 miles having been covered in 6½ hours. The next day it proceeded to Folkestone, the journey occupying 55 minutes.

Berlin to Stockholm.

GERMANY is losing no time in commencing aerial services. On the morning of May 10 a large German aeroplane piloted by Herr Sablatnig, carrying three passengers and mail, arrived at Stockholm from Berlin. The flight was made in two stages, the first, from Berlin to Copenhagen, taking 2 hours 50 minutes, while the second, from Copenhagen to Stockholm, occupied 4 hours 15 minutes.

AVIATION IN PARLIAMENT

R.A.F. Pay Office, Woking

Lieut.-Col. Sir A. WARREN, in the House of Commons on May 12, asked the Secretary of State for War if his attention has been called to the conduct of affairs at the Royal Air Force Pay Office at Woking; if he is aware that numerous complaints are being received as to the unbusinesslike methods in operation there, imposing much annoyance and hardship upon men entitled to pay; and if he will have the matter inquired into?

Lieut.-Col. Archer-Shee asked the Secretary of State for War whether he is aware that many demobilised men of the Royal Air Force are complaining of the long delay in getting their gratuity and back pay; and whether he will take steps to ensure that the Royal Air Force, Pay Office, Woking, clears up these men's accounts within a reasonable period after demobilisation?

Maj.-Genl. Seely: The work of the Woking Pay Office has been under constant supervision, and all possible steps have been taken to speed up the clearance of the accounts. Arrears at one time existed owing to an increase in the rate of demobilisation, but those arrears have now been cleared up. The complaints received have been in many cases due to misunderstanding on the part of the men concerned of the deferred payment system. As previously stated, this system was introduced to enable men who were in a hurry to return to civil life to receive demobilisation in advance of the final settlement of their accounts. All men accepting the scheme signed a personal statement to the effect that the final balance due to them would not be claimed until three months after the expiration of their demobilisation furlough. In spite of this, numerous demands for immediate settlement are being received. In these cases the accounts are being settled several weeks earlier than was promised, and in necessitous cases advances are being made additional to those which were made to the men on their leaving their units. The deferred payment system having served its purpose, has now been cancelled.

Cramlington Aerodrome

Sir FRANCIS BLAKE, on May 13, asked the Secretary of State for War whether the construction of the aerodrome at Cramlington, Northumberland, is still being proceeded with; what number of men are being employed in such construction; what rates of pay and travelling allowances are being paid them; and whether it is the policy of the military authorities to establish a permanent station at this place?

The Under-Secretary of State for Air (Genl. Seely): The answer to the first part of the question is in the negative, but 22 men are at present employed in clearing up materials. The rates of pay are those fixed by the Tyne and Blyth Conciliation Board for Building Trades. It is not intended to establish a permanent station.

R.A.F. Gratuities

Lieut.-Col. Sir F. HALL asked the Under-Secretary of State to the Air Ministry whether warrant officers, late Royal Naval Air Service, who received the rank of second lieutenant at the amalgamation of the two services, the Royal Naval Air Service and Royal Flying Corps, on April 1, 1918, are entitled to the same gratuities for time served as warrant officers, Royal Naval Air Service, as those laid down for temporary officers in the Royal Navy?

Maj.-Genl. Seely: Temporary warrant officers of the Royal Naval Air Service who have been granted temporary commissions in the Royal Air Force are entitled to the same gratuities in respect of their warrant service as temporary officers in the Royal Navy.

Station Hotel, Stirling

Maj. GLYN asked the Under-Secretary of State to the Air Ministry whether immediate steps can be taken to release the Station Hotel, Stirling, from the control of the Air Service on account of the shortage of hotel accommodation, and the near approach of the summer season; and whether since last November the office staff of the Royal Air Force in Stirling has been reduced to such an extent that rooms formerly used in the hotel are now standing empty?

Maj.-Genl. Seely: Orders have been given for the early relinquishment of these premises, and I expect that they will be vacated in the course of the next two or three weeks. At the moment all the available rooms in the hotel are occupied.

Women's Royal Air Force

Lord H. Cavendish-Bentinck asked the Secretary of State for War how many women officers and members applied for enrolment in the Women's Royal Air Force during the time that Miss Douglas Pennant was commandant of the Women's Royal Air Force?

Mr. Churchill: The number of enrolments (including transfers from the Women's Royal Naval Service and the Queen Mary's Army Auxiliary Corps) during the period referred to were: Officers, 262, and other ranks, 15,128.

R.A.F. Lieutenants' Pay

Col. DU PRE, on May 14, asked the Under-Secretary of State to the Air Ministry whether the pay of a second lieutenant of the Royal Flying Corps was 12s. per day as equipment officer; whether on transfer to the Royal Air Force these officers received a form stating that their pay would not be reduced; and, if so, whether he can state why such an officer on promotion to lieutenant and appointment as court-martial officer was paid at the reduced rate of 11s. 6d. per day?

Genl. Seely: The pay of a second lieutenant holding the appointment of equipment officer, third class, in the Royal Flying Corps was as stated in the question, and such officers, in common with others transferred to the Royal Air Force on its formation, were given an undertaking that they would not suffer in the matter of pay, so long as they continued to carry out duties similar to those falling to them prior to transfer. On vacating the appointment of equipment officer, on appointment as courts-martial officer, an officer of the Royal Air Force would be transferred from the technical to the administrative branch of the force, and would draw the rate of payof his rank in that branch, whether higher or lower than his previous rate. If my hon. and gallant friend will communicate with me on any particular case he may have in mind, I will have its merits investigated.

R.A.F. Kennington Garage

Lieut.-Col. MOORE-BRABAZON asked the Under-Secretary of State to the Air Ministry whether he is aware that, in spite of the fact that the Women's Royal Air Force are asking for more drivers, women of long experience are being dismissed from Kennington; why it is that such action is being taken at Kennington alone; whether the employment of newly-enlisted men without previous experience, costing the State 14s. and 29s. a week more for light and heavy cars respectively, is in any way equitable or economical; whether he will take steps to see that the general management of the Kennington garage be investigated, both from the point of view of its attitude towards members of the Women's Royal Air Force and economy generally in personnel?

Maj.-Genl. Seely: Any recent recruitments of women drivers have been for the Mobile Division of the Women's Royal Air Force. The dismissals at Kennington have been of women belonging to the Immobile Division, who can only be employed in the neighbourhood of their own homes, and they have been replaced, so far as possible, by demobilised Service men. I am advised that, taking all factors into account, this action tends to economy. With regard to the last part of the question, I am having special inquiries made.

Aeroplanes (Disposal)

Lieut.-Col. Sir SAMUEL HOARE on May 15 asked the Under-Secretary of State to the Air Ministry whether he can form any estimate of the loss involved to the State by the destruction, at the Cove Camp, Farnborough, of a number of new aeroplanes never used and many not even unpacked; and whether he could not find a market in neutral countries or amongst civilian purchasers for the sale of these brand new goods?

The Under-Secretary of State for Air (Maj.-Genl. Seely):

1. On the signing of the Armistice the Air Council had some 20,000 aeroplanes and seaplanes on charge, and machines were being produced at the rate of 4,000 a month. The storage available including hirings which had to be given up was insufficient to enable these numbers to be stored under cover as well as the new machines of which the Air Council would have to take delivery.

2. The Air Council had three alternatives:—(1) To erect or hire buildings to store all serviceable machines, in the hopes that a market would be found for those not required by the Royal Air Force in peace. (2) To break up the least valuable machines, sending the useful portions to the Disposal Board and selling the remaining material as scrap. (3) To remove the instruments and engines, burn the machines and sell the metal remains as scrap.

3. The first alternative would have been very costly and the market for the older machines before they became unserviceable in store did not justify such a course. The third would have required less expenditure of labour, but the disposal authorities of the Ministry of Munitions considered that a market might be found for the salved parts, and the second alternative was, therefore, adopted by the Air Council.

4. The Air Council, in accordance with the policy they adopted, divided the machines into three classes: (a) Standard machines for the Royal Air Force. (b) Machines obsolete for use in the Royal Air Force in peace or war, but suitable for civil aviation. (c) Machines obsolete for war purposes, and not suitable for civil flying.

5. On March 31 there were 15,700 machines of the first class; of these large numbers are surplus to the requirements of the Royal Air Force, and are available for sale. On the same date there were approximately 1,000 of the second class, also available for sale to the public. There were 3,600 of the third class still awaiting reduction to produce.

6. The Disposal Board of the Ministry of Munitions are responsible for selling machines of class 1 and 2 not required by the Royal Air Force, but the Board have no large storage accommodation available, so that the machines for disposal usually remain in the Royal Air Force storage until a market is found for them by the Board.

I am sending an officer to make sure that the policy of the Council is being efficiently carried out at Farnborough and Henlow, but I have no doubt that the policy adopted by the Air Council after the Armistice was sound, and involved the least possible cost to the State.

Lieut.-Col. Malone: May I ask whether any attempt has been made to find a market for these machines in foreign countries and is he aware that some of these machines which have been destroyed are new machines straight from the manufacturers?

Maj.-Genl. Seely: I deal with the question in the very long statement which I have read and I must apologise to the House for its length. The machines from which the engines are taken out and the rest disposed of by auction to the best bidder are machines which are not suitable for the Air Force and are not suitable for civilian flying. Some of these machines are quite new, but the science of flying progresses so quickly that many of them are now obsolete. It would be wrong to send our flying men in the Royal Air Force into the air on those machines and it would be equally wrong to release them for civil flying. If we could have foreseen seven or eight or ten months what we know now we would not have made them, but that is inevitable

Lieut.-Comdr. Kenworthy: Have we come to the end of the obsolete machines, and what about the contracts?

Maj.-Genl. Seely: We have practically come to the end of the obsolete machines. The question of the closing of the contracts is a matter for the Minister of Munitions and not the Air Force.

Timber for Aeroplanes

Mr. REMER asked the Secretary of State for War how many machines, manufactured and partly manufactured, had to be discarded owing to cypress being found an unsuitable wood for use on aeroplanes?

Maj.-Genl. Seely: No machines had to be discarded for this reason, but the substitution of other woods involved the supply of about 900 main planes, 100 main spars and 55 tail planes for machines on charges of the Royal Air Force. Substitutions were also required for machines in the hands of contractors, and particulars of these are being sought for in accordance with the undertaking given to my hon. friend in answer to his previous question on this subject.

Mr. Remer asked the Secretary of State for War if he will give the names of his present advisers as to the most suitable woods necessary for use on aeroplanes; what were their pre-war occupations; and what practical experience of sawing and manufacturing timber they possess?

Maj.-Genl. Seely: The Timber Committee of the Conjoint Board of Scientific Societies, in connection with the Royal Society, advises on the suitability of timber for aeroplanes. I will send my hon. friend a list of their names.

Parachutes

Maj. PRESCOTT asked the Under-Secretary of State to the Air Ministry whether his attention has been called to the verdict of death by misadventure returned by the coroner's jury at the inquest on Mr. Legh, who was recently killed in an aeroplane accident at Finchley; whether, in view of the fact that his life might have been spared had his machine been equipped with a parachute, he will so amend the Civil Air Regulations as to compel the provision of parachutes on aeroplanes used for civilian flying purposes; and whether there is any Regulation in force at the present time imposing a similar obligation in regard to service aeroplanes as a safeguard for our airmen?

Maj.-Genl. Seely: The answer to the first part of the question is in the affirmative. As regards the second and third parts, the provision of parachutes is, as I have previously stated, receiving the closest attention of the Air Ministry, but their development has not at present reached a stage in which compulsory universal provision would be either practicable or advantageous for military or civil aviation.

"A New Prime Mover"

AT the meeting of the Royal Society of Arts, on Monday, Capt. Frank E. D. Acland, R.A., will read a paper on "A New Prime Mover of High Efficiency and British Origin." The chair will be taken at 4.30 p.m. by the Hon. Sir Charles Algernon Parsons, K.C.B., F.R.S

THE ROYAL AIR FORCE

London Gazette, May 13

The following temporary appointments are made :—

Staff Officer, 2nd Class.—(Q.) Capt. C. A. Shaw, D.S.O., relinquishes the actg. rank of Lieut.-Col., and to be actg. Maj. (from March 15 to April 30), vice Lieut. (Hon. Capt.) G. W. Frost.

Staff Officer, 4th Class.—(Air.) Sec. Lieut. T. J. Q. O'Hara ; May 7

Flying Branch

Capt. (actg. Maj.) T. F. Hazell, D.S.O., M.C., D.F.C., to be Capt. (A.), and relinquishes the actg. rank of Maj. ; April 2.

Sec. Lieut. M. G. Stewart (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut. (O.) ; April 23, 1918.

Sec. Lieut. F. G. Gage (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut. (A.) ; July 15, 1918.

P.F.O. H. L. Buckley (late R.N.A.S.) is granted a temp. commn. as Sec. Lieut. (A. and S.) ; Oct. 12, 1918.

The following relinquish their commns. on ceasing to be employed :—Sec. Lieut. J. H. Lowry ; Oct 7, 1918. Lieut. A. L. Stover (Lieut., Manitoba R.) ; Dec. 13, 1918. Lieut. N. R. D Henderson (Lieut., Manitoba R.) ; Jan. 26. Lieut. (Hon. Capt.) W. D. Spero ; Feb. 3. Lieut. (actg. Capt.) J. A. Adam (Lieut., B. Col. R.) ; Feb. 6. Sec. Lieut. (Hon. Lieut.) C. T. Mee (Lieut., Can. F. Art.) ; Feb. 11. Sec. Lieut. (Hon. Lieut.) A. R. Beveridge (Lieut., C. Ont. R.) ; March 15. Lieut. A. N. Jenks (Lieut., Quebec R.), Lieut. E. A. Plamondon (Lieut., W. Ont. R.) ; March 17. Lieut. (Hon. Capt.) B. B. Bishop (Capt., Can. A.S.C.), Lieut. F. L. Barclay (Cent. Ont. R.) ; March 18. Sec. Lieut. (Hon. Lieut.) G. A. F. Riley (Lieut. E. Ont. R.), Sec. Lieut. J. P. Mackenzie (Lieut., R. Regt., Art.) ; March 24. Lieut. R. F. Given (Lieut., C. Ont. R.), Lieut. H. C. McKinney (Lieut., Quebec R.), Capt. V. E. Schweitzer (Capt., Manitoba R.) ; March 31. Capt. G. R. L. Snow (Lieut., R.N.) ; April 4. Sec. Lieut. (Hon. Lieut.) C. E. Rattee (Lieut., N. Brunswick R.) ; April 9. Lieut. C. A. Chisnall (Lieut., Alberta R.) ; April 13. Lieut. R. M. Roberts (Lieut., B. Col. R.) ; April 16. Sec. Lieut. (Hon. Lieut.) L. R. McKenna (Lieut., E. Ont. R) ; April 25.

(Then follow the names of officers who are transfd. to the Unemployed List under various dates. Owing to great pressure on our space, we regret that we are unable to reprint this portion of the List.—ED.)

The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—E. F. Driver ; April 1, 1918 (substituted for notification in *Gazette* Jan. 7). J. St. G. George (N. Staff. R.) ; May 3.

Lieut. H. L. Yates resigns his commn. ; May 14.

Sec. Lieut. L. F. Chisenhall relinquishes his commn. on account of ill-health contracted on active service, and is permitted to retain his rank ; April 25.

Sec. Lieut. H. A. Bradshaw to take rank and prec. as if his appointment as Sec. Lieut. bore date March 7.

The initials and rank of Sec. Lieut. F. H. J. Bull are as now described, and not Lieut. F. J. A. Bull as stated in *Gazette* Feb. 28.

The notification in *Gazette* March 28 concerning Sec. Lieut. H. H. R. Hanford is cancelled.

The notification in *Gazette* April 4 concerning Sec. Lieut. N. V. Scott is cancelled.

Administrative Branch

Lieut. (actg. Capt.) C. G. Darwin, M.C. (R.E.), is granted a temp. commn. as Lieut., and to be actg. Capt. while so employed ; May 22, 1918.

Lieuts. (A.) to be Lieuts. : T. H. Butler ; April 1, 1918 (substituted for notification concerning this officer which appeared in *Gazette* Feb. 21). R. N. Swann ; April 24. C. J. Gillan ; April 26.

H. J. W. Fletcher (Lieut., Northants R.) is granted a temp. commn. as Lieut. ; Oct. 4, 1918 (seniority from April 1, 1918).

Lieut. J. A. Stedman (R.F.A., T.F.) is granted a temp. commn. as Lieut. ; Oct. 28, 1918 (substituted *for notification concerning this officer* which appeared in *Gazette* Jan. 7).

Sec. Lieuts. to be Sec. Lieuts., from (A.) :—H. West ; Dec. 7, 1918 (substituted for notification in *Gazette* Feb. 14). H. E. Barry, S. D. Connolly, N. F. Hoxie, F. H. Lane, W. P. Taltavall ; April 17. H. V. A. Salter ; April 26.

Sec. Lieut. H. Castle-Mason to be Sec. Lieut., from (A. and S.) ; April 17.

Sec. Lieuts. to be Sec. Lieuts., from (O.) :—G. W. Sharp ; Nov. 22, 1918 (substituted for notification in *Gazette* Feb. 4) E. C. Richards ; April 17. W. Robinson ; April 28. H. Cahill ; April 29.

The following relinquish their commns on ceasing to be employed :—Sec. Lieut. E. B. Sprowson ; July 13, 1918. Lieut. S. H. H. Heaver (Ches. R.) ; Feb. 10.

(Then follow the names of 56 officers who are transfd. to the Unemployed List under various dates.)

Sec. Lieut. S. R. S. Burnett relinquishes his commn. on account of ill-health and retains his rank ; May 6 (substituted for notification in *Gazette* Feb. 19).

The surname of T. W. B. Hill is as now described and not T. W. B. Mill, as stated in *Gazette* of Feb. 4.

The Christian name of Wilfred Bolt is as now described, and not as stated in *Gazette* of Jan. 31.

The name of Sec. Lieut. E. J. Syer is as now described, and not as stated in *Gazette* of March 25.

The notification concerning Sec. Lieut. W. Pollock which appeared in *Gazette* of Feb. 11 is cancelled.

The notification in *Gazette* of April 18 concerning Sec. Lieut. G. Jacob is cancelled.

The notification in *Gazette* of May 2 concerning Lieut. H. B. Turner is cancelled.

Technical Branch

Capt. (actg. Maj.) W. B. Cushion to be Maj., Grade (B), from (Ad.) ; May 6, 1918.

W. J. F. Dutson (actg. Lieut., R.N.V.R.) is granted a temp. commn. as Capt. ; April 1, 1918 (since demobilised).

Lieut. H. K. Gibson to be Lieut. (Grade (B), from (N.D.) ; Feb. 20.

Sec. Lieut. J. F. Groom to be Sec. Lieut., Grade (A), from (Ad.) ; March 7.

Sec. Lieuts. to be Sec. Lieuts., Grade (B), from (Ad.) :—D. Morton ; Feb. 19. J. H. Payne ; Feb. 21.

Lieut. (Hon. Maj.) C. G. C. Hamilton, M.P. (Maj., Lond. R., T F.), relinquishes his commn. on ceasing to be employed ; Jan. 31.

(Then follow the names of 76 officers who are transfd. to the Unemployed List under various dates.)

Medical Branch

Maj. H. Pritchard to be actg. Lieut.-Col. while employed as President, R.A.F. Invaliding Board from Sept. 6, 1918, to April 30.

Transferred to Unemployed List :—Capt. J. B. Stevenson, M.C., M.B. (R.A.M.C.) ; Feb. 25. Capt. J. M. Wyatt ; March 8. Capt. W. G. Helsby ; April 4. Capt. R. M. Dannatt ; April 26. Capt. C. F. Graves ; May 3.

Memoranda

The following relinquish their commns. on ceasing to be employed :—Temp. Hon. Lieut. O. T. Jones ; March 31. Capt. C. W. C. Browne (Lieut., R.N.) ; May 5. Lieut. (Hon. Capt.) F. Gay, late R.A.F., and is permitted to retain rank of Capt. ; May 14.

(Then follow the names of 18 officers who are transfd. to the Unemployed List under various dates.)

London Gazette, May 16

The following temporary appointments are made :—

Staff Officer, 1st Class (P.).—Lieut.-Col. (actg. Brig.-Genl.) C. L. N. Newall, C.M.G., A.M., and to relinquish the actg. rank of Brig.-Genl. ; April 17.

Staff Officers, 3rd Class (P).—Lieut. (actg. Capt.) D. N. Stewart-Savile, M.C., and to retain the actg. rank of Capt. whilst so employed ; Jan. 3 till April 30 (substituted for notification in the *Gazette* of April 25). (O.) Lieut. (actg. Capt.) L. V. Boxer ; Feb. 1, and to retain the actg. rank of Capt. till April 30.

Flying Branch

Maj. S. J. Goble, D.S.O., O.B.E., D.S.C., to be actg. Lieut.-Col. whilst employed as Lieut.-Col. (A.) (from March 15 to April 30). Capt. O. A. Butcher, D.S.C., to be Capt. (K.B.) from (S.O.) ; April 20. Lieut. I. Morgan to be actg. Capt. whilst employed as Capt. (K.B.) without pay and allowances of that rank ; from March 20 to April 30. Lieuts. to be Lieuts. (A.) :—(D.) F. J. Williams, from (Ad.) ; Feb. 4. H C. G. Allen, from (S.O.) ; May 1. Sec. Lieuts. to be Lieuts. :—H. E. Fenwick ; April 21, 1918. (Hon. Lieut.) W. Black, M.C. ; June 1, 1918. J. W. Lissett ; June 9, 1918. W T Smith ; Aug. 30, 1918. H. M. Cartwright ; March 9. Sec. Lieut. (Hon. Lieut.) N. F. Penruddocke to be Sec. Lieut. (O.) from (Ad.) ; April 25 (and to be Hon. Lieut.).

The following relinquish their commns. on ceasing to be employed :—Sec. Lieut. R. D. Brownlie ; Dec. 28, 1918 (substituted for notification in the *Gazette* of Dec. 13, 1918). Lieut. H. K. Thompson (Lieut., C. Ont. R.) ; Jan. 10. Lieut. J. Macklen (Lieut., R. Can. Dragoons) ; Jan. 20. Lieut. (Hon. Capt.) A. C. McKelvie (Suff. Yeo.) ; Jan. 29. Lieut. C. E. French (Lieut., E. Ont. R.) ; Feb. 16. Lieut. (Hon. Capt.) P. R. White (Capt. E. Ont. R.) ; Feb. 18. Lieut. C. MacLaughlin (Lieut., Can. F. Art.) ; Feb. 20. Sec. Lieut. G. C. Easton (Capt., Manitoba R.) ; Feb. 28. Lieut. (actg. Capt.) M. W. Richardson (Capt., C. Ont. R.) ; March 10. Lieut. A. St. J. Highstone (Lieut., E. Ont. R.) ; March 17. Lieut. A. Goby (Lieut., Sask. R.) ; March 18. Sec. Lieut. (Hon. Lieut.) M. E. Patterson (Lieut., Alb. R.) ; March 21. Lieut. G. B. Dixon, M.M. (Lieut., Cent. Ont. R.), Lieut. R. R. Haley (Lieut., Nova. Scotia R.) ; March 31. Sec. Lieut. A. C. Taylor (C. Ont. R.) ; April 11. Maj. G. C. O. Usborne (Maj., Can. M.G.C.) ; April 14. Lieut.-Col. G. C. St. P. du Bombasle (Capt., Nova Scotia R.) ; April 18. Lieut. S. Guillon (Lieut., Sask. R.) ; April 21. Maj. O. C. MacPherson (Maj. Can. Engrs.) ; April 23. Lieut. G. R. Thornley (Sec. Lieut., Lanc. Fus.) April 30.

(Then follow the names of 136 officers who are transfd. to the Unemployed List under various dates. We regret that owing to great pressure on our space we are unable to reprint this portion of the List.—ED.)

Capt. D. F. Ellis relinquishes his commn. on account of ill-health, and is permitted to retain his rank ; May 2. The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—M. D. G. Drummond (contracted on active service), R. W. Duff (contracted on active service) ; April 29 A. Hartley, A. Impey ; May 6. Lieut. (actg. Capt.) W. E. Holland, Scott. Horse Yeo., relinquishes his commn. on account of ill-health ; May 5. The following Sec. Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—A. Nicholson ; April 24 (substituted for notification in the *Gazette* of Feb. 14). W. T. Leonard (contracted on active service) ; May 1. S. M. Myles (contracted on active service) ; May 3. W. A. Rahn ; May 8. Sec. Lieut. S. E. Calvert resigns his commn. ; May 17. Sec. Lieut. G. B. Noble is antedated in his appointment as Sec. Lieut. (A.) ; Aug. 24, 1918. The surname of Sec. Lieut. F. Wight is as now described, and not Wright, as stated in the *Gazette* of April 1. The notification in the *Gazette* of Feb. 4 concerning Lieut. W. C. Marsh is cancelled. The notification of March 25 concerning Sec. Lieut. H. B. Hewat is cancelled. The notification of April 4 concerning Lieut. W. H. Gibson is cancelled.

Administrative Branch

Majs. to be Majs. from (S.O.) :—J. St. A. King, E. F. Hutchinson ; May 1. Capts. to be Capts. from (S.O.) :—E. Cameron, R. D. Hallam ; April 1. W. M. Cumming ; May 1. R. L. Allport ; May 6. Capt. E. P. Hardman, D.F.C., is confirmed in his rank of Capt. ; May 5. Lieuts. to be graded for purposes of pay and allowances as Capts. :—H. J. W. Fletcher (Hon. Capt.). E. V. Tarrant ; May 1 Lieuts. to be actg. Capts. whilst employed as Capts. : H. J. W. Fletcher (from Jan. 4 to April 30). (Hon. Capt.) E. V. Tarrant ; from Jan. 27 to April 30. Sec. Lieut. (Hon. Capt.) (actg. Capt.) E. Codyre to be Lieut., and to retain his hon. rank ; July 21, 1918. Lieuts. (actg. Capts.) to be Lieuts., from (F), and relinquish their actg. rank of Capt. on ceasing to be employed as Capt. :—M. R. Helliwell ; April 17. V. Wigg ; April 28. Lieuts. (A.) to be Lieuts. :—T. A. Akin, H. R. Caffyn, C. W. L. Calvert, F. W. C. Davies, C. L. Fletcher, G. S. Lee, B. Fitz W. Levett, A. W. Symington, M.C., P. W. Smith, L. G. Taylor, N. J. Taylor ; April 17. Lieut. L. C. Beaver to be Lieut., from (A. and S.) ; April 17. Lieuts. (O.) to be Lieuts. :—J. R. Currington, E. R. V. Callett, W. E. McLean, M.C. ; April 17. Lieut. L. A. Rees to be Lieut., from (S.) ; April 1. Lieuts. to be Lieuts., from (S.O.) :—D. Blairman, F. A. Corbett, Sec. Lieut. A. H. Petch to be Sec. Lieut., from (A.) ; April 17. Sec. Lieuts (late Gen. List, R F C., on prob.) are confirmed in their rank as Sec. Lieuts. :—A. Tulloch ; Sept. 2, 1918. F. J. Deane ; Nov. 16, 1918.

The following relinquish their commns. on ceasing to be employed :—Lieut. (Hon. Capt.) (actg. Capt.) W. S. Ford (E. Surr. R.) ; Dec. 6, 1918. Capt. S. Morris (R.A.S.C.) ; March 4. Capt. (actg. Maj.) G. H. C. the Earl of Rocksavage (Capt., 9th Lancers) ; April 12.

(Then follow the names of 15 officers who are transfd. to the Unemployed List under various dates.)

Sec. Lieut. J. G. Elliott relinquishes his commn. on account of ill-health and is permitted to retain his rank ; May 9. Sec. Lieut. G. A. Beith is removed the Service, his Majesty having no further occasion for his services as an officer ; Feb. 14. The unit of Lieut. H. Townsend (Durh. L.I.) is as now described, and not High. L.I., as stated in *Gazette* Nov 1, 1918. The notification in *Gazette* Feb. 28 concerning Lieut. M. Helliwell is cancelled. The notification in *Gazette* May 9 concerning C. A. Henshaw is cancelled.

SIDE-WINDS

THESE are the days when the most radical innovations in our daily comings and goings rapidly become accomplished facts. It seems quite natural to receive from the Lepaerial Travel Bureau, whichh as been established in Piccadilly Circus by the Lep Transport and Depository Ltd., a brochure setting forth, in some detail, the facilities they are able to offer in the way of bookings of passengers and cargoes for aerial transport. Apart from the actual information it contains regarding the Bureau, there are many photographs of famous pioneers, well-known constructors and flying heroes. There is also a series of sketches illustrating the evolution of travel, while another series of photographs shows a few steps in the development of the aeroplane. The bureau has prepared a great book which, when completed, will contain the signature of each of the first thousand persons to book a flight by Lepaerial Travel. It is intended to present this "Historic Roll" which will be handsomely bound and decorated, to the British Museum as a permanent record.

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A NOTE from the Sopwith Aviation and Engineering Co. Ltd., announces that they have just appointed Major H. A. Geaussent to take charge of the export department for their A.B.C. motor-cycles. Major Geaussent is well known to many of our Colonial friends, having been for several years previous to the War export manager for the Hutchinson Tyre Co. Not only has Major Geaussent a thorough knowledge of the trade overseas, but, what is even more important, a keen appreciation (gained by continual visits to and residence in South Africa, Australia, New Zealand and other parts) of the requirements of Colonial houses. During the War, Major Geaussent has seen a great deal of active service, having been in the Dardanelles, Egypt, and over two years in France, where he was in command of a machine-gun company.

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IT has been decided to change the name of the A.G.S. Manufacturers' Association to the Association of Manufacturers of Aircraft Parts. The headquarters are at 60, Haymarket, S.W. 1.

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FROM time to time I have referred to the advantages enjoyed by users of "Triplex" in the matter of insurance premiums. A concrete instance is to hand in the shape of the new Safety First policy issued by the North and South Insurance Corporation. There is a substantial reduction for cars fitted with windscreens of Triplex safety glass, and there is a still further reduction if all the glass in the car is Triplex.

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IT is a very strong evidence of confidence and, moreover, in the public's interest, good hearing, that the Cosmos Engineering Co., Ltd., has requested the Air Ministry to continue the War-time inspection system on the Jupiter engine manufactured by this firm. The A.I.D. will make an examination of each engine on stripping after its preliminary test, and will observe the final trial in addition to carrying out certain tests on material during the process of manufacture, and the results obtained will be embodied in a certificate issued with every engine on delivery.

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WITH reference to the trip from Madrid to Barcelona mentioned in last week's FLIGHT we learn that this was carried out on a Napier engined D.H. 9 Airco machine, and in addition to the pilot it carried an observer and 750 copies of a Spanish periodical. The flight was accomplished in 2 hrs. 30 mins., and it certainly does show up the difference between air and railway transport, when one considers that an express train takes 15 hours for the journey.

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NOT only have the Motor and Aircraft Supplies Co. been appointed sole selling agents for the British Empire for the Rushmore Electric starting and lighting set for motor cars, but they are also handling the famous Rushmore lamps, acetylene as well as electric, on which the technical experts of Rushmores, Ltd., have been engaged, particularly with a view to supplying the requirements for civilian aviation. They are in the position of being able to quote aircraft manufacturers, aerodrome proprietors and others for the lights required to be carried by aeroplanes in the future, also the necessary lighting for aerodromes, either private or those already approved by the Air Ministry as termini for aerial lines in this country.

As far back as 1912, when the first night flying exhibition was held at the London Aerodrome, Hendon, organised by Mr. Claude Grahame White, that gentleman, with his usual knowledge of up-to-date requirements, called upon the Rushmore firm at 24 hours' notice to supply and fit up headlights and searchlights for the occasion. The directors of Rushmore's, with this limited notice, fitted up the London Aerodrome, Hendon, with their famous acetylene headlights for assisting the aviators in landing, and in addition to which Mr. Grahame White had his aeroplane fitted with Rushmore lamps.

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RESETTLEMENT

THERE are many officers and men of the R.A.F., who are demobilised or are about to be demobilised.

In order to assist those who are undecided or are seeking advice as to their prospects in civil life, the Editor has arranged for an expert, with wide experience of service, industrial and educational conditions, to give advice to those who may solicit it through the medium of this Journal.

Applications, which must be in writing, should be marked *Resettlement*, and addressed to the Editor, FLIGHT, 36, Great Queen Street, Kingsway, W.C. 2. They will be dealt with in these columns, as far as possible, in rotation.

H.E.P., EX-LIEUT., R.A.F.—You will be best advised to return to college and complete your degree course. After obtaining your diploma, you should have no difficulty in securing a post, with good prospects; moreover, your Service experience will give you a pull over those who do not possess such excellent practical knowledge. You should apply to the Appointments Department of the Ministry of Labour for financial aid to complete your interrupted college career.

VALVE (*Wireless*).—In view of your lack of works or college training, and also your youth, we think you will be best advised to take a course of electrical engineering with a view to specialising in wireless (telegraphy and telephoning). Your service experience, under these circumstances, will prove most valuable. You should avail yourself of the facilities offered by the Appointments Department of the Ministry of Labour.

A.J.R. (*Engines*).—If you are a skilled fitter, having served your time as an apprentice, you should have no difficulty in obtaining employment unless you stipulate aircraft work only. See also reply to J.A.H., Ex-Flight-Sergt., FLIGHT May 15, 1919.

C.L.D., EX-RIGGER.—As you merely mention your service experience we find it difficult to offer you advice. There are numerous highly skilled riggers available and only a small proportion of these will be required for civilian aviation in the immediate future. Of course, you can approach firms with whose machines you are familiar, but you should give particulars of your pre-War training and experience as well as that acquired in the R.A.F.

B.D.C., EX-SERGT., R.A.F.—We regret we do not know of a particular address to which demobilised N.C.Os. and men of the R.A.F. can apply for employment in civil aviation. As you have given no particulars concerning yourself other than that you have been in the R.A.F., we are unable to advise you.

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PUBLICATIONS RECEIVED

Jane's Pocket Aeronautical Dictionary. London: Sampson Low, Marston and Co., Ltd. Price 1s. 6d.

Housing by Public Utility Societies: The Government Proposals. London: Local Government Board, Intelligence Division, Whitehall. Price 1d.

A Study on the Performance of "Night-Glasses." By L. C. Martin, D.I.C., A.R.C.S., etc. Bulletin No. 3, Department of Scientific and Industrial Research, Advisory Council. London: H.M. Stationery Office.

The Design and Construction of Aero Engines. By C. Sylvester, A.M.I.E.E. London: The "Aeroplane" and General Publishing Co., Ltd., 61, Carey Street, W.C. 2. Price 6s. net.

Automobile and Aero Engines. By René Devillers. Translated by W. J. Walker, B.Sc., Capt., R.A.F. London: E. and F. N. Spon. Price, 16s. net; post free in the United Kingdom, 16s. 6d.; abroad, 16s. 10d.

Carpentry for Beginners (The Woodworker Series). London: Evans Brothers, Ltd., Montague House, Russell Square, W.C. 1. Price 3s. 6d. net.

Catalogue

Supplement au Catalogue de Photographies Documentaires. Jacques Boyer, 5 bis, Rue Saint-Paul, Paris.

COMPANY MATTERS

Aster Engineering Co. (1913), Ltd.

THE report of the Aster Engineering Co. (1913) to December 31 last states that the balance brought forward was £31,927, from which has been paid excess profit and dividend £15,757, leaving £16,170. Profit for year was £30,302, making £46,472. Deducting depreciation (£5,195), reserve for liabilities and bad debt (£536) and interim dividend (£3,727), there is left £37,014. The directors propose a final dividend of 5 per cent. (free of income-tax), making 10 per cent. for the year, and to carry forward (subject to excess profits tax) £33,282.

Fellows Magneto Co., Ltd.

THE report of the directors for the year ended December 31, 1918, states that a considerable increase in output was secured during the year, notwithstanding the many difficulties and various delays incidental to war conditions. Higher prices were granted by the Ministry of Munitions as from August, 1918, to compensate for the enhanced cost of labour and material.

The manufacture of lighting and starting sets and of other electrical motor car accessories has been undertaken, and deliveries of these are now being made. During the past year the paid-up capital was increased from £66,533 to £114,696. Considerable further capital is now required in connection with the very profitable contracts accepted by, or offered to, the company. Subject to the approval of the shareholders and to such modifications as may be considered necessary, the directors propose to double the present authorised capital, and to issue a sufficient number of shares to provide the requisite funds for increasing the capacity of the factory and dealing with the extension of the business.

The result of the company's working for the year ended December 31, 1918, after allowing £4,637 16s. 6d. for depreciation and the writing down of preliminary expenses, shows an available profit of £14,128 14s. 5d. (as against £8,514 0s. 3d. for the previous period of eighteen months), to which must be added the amount of £1,181 19s. 8d., brought forward from the previous year, making £15,310 14s. 1d. in all. An interim dividend of 4 per cent. has already been paid on the 8 per cent. cumulative participating preferred shares, absorbing £1,866 13s. 7d.

The directors recommend the payment of the final cumulative dividend of 4 per cent. (less tax), together with a participating dividend of 1½ per cent. (less tax) on the preferred shares, making 9½ per cent. for the year, and a dividend of 24 per cent. (less tax) on the ordinary shares, to all shareholders on the register on May 14, 1919, whose shares were fully paid on December 31, 1918. This will absorb in all £12,180 12s. 7d., leaving a balance of £3,130 1s. 6d. to be dealt with. This sum, after deduction of such excess profits tax (if any) as may be payable by the company, it is proposed to place to reserve, less the sum of £1,000, which will be carried forward.

Subject to the approval by the shareholders of the company of the proposed issue of the new 8 per cent. cumulative participating preferred shares and ordinary shares, at an extraordinary general meeting to be held shortly, the directors are now prepared to register the names of applicants for the new shares, particulars of which may be obtained from the Secretary, Fellows Magneto Co., Ltd., 21, St. James's Street, London, S.W. 1.

Siddeley-Deasy Motor Car Co., Ltd.

THE directors of the Siddeley-Deasy Motor Car Co., Ltd., announce that the offer made by the Armstrong-Whitworth Development Co. for the exchange of shares having been accepted by the holders of 92½ per cent. of the shares, such offer is now binding, and the new certificates will be issued in due course.

Whitehead Aircraft (1917), Ltd.

THE report of Whitehead Aircraft (1917), Ltd., to September 30 last, shows a profit of £19,686, out of which interim dividend of £9,304 on the preference shares has been paid, leaving £10,382 to be carried forward. Out of this the directors have paid the final dividend for the year on the preference shares. During the period the company has been a controlled establishment, its operations being entirely confined to work under Government contract.

NEW COMPANY REGISTERED

FAIREY AND CHARLES, LTD.—Capital £50,000, in £1 shares. Manufacturers of and dealers in motor cars, aeroplanes, cycles, etc. Managing directors: C. R. Fairey and F. M. Charles. Solicitors: Ashurst, Morris, Crisp and Co., 17, Throgmorton Avenue, E.C. (2).

Aeronautical Specifications Published

Abbreviations:—cyl. = cylinder; I.C. = internal combustion; m. = motors.

APPLIED FOR IN 1916

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

Published May 15, 1919

11,082. BARR AND STROUD, A. BARR and W. STROUD. Instrument for measuring deflection and angle of sight correction with appliance for showing fuse indication corresponding to predicted position of target. (125,455.)
11,220. BLACKBURN AEROPLANE AND MOTOR CO. and R. BLACKBURN. Aerial propellers. (125,456.)
11,276. G. F. PHILLIPS. Apparatus for calculating ranges of aircraft from observations of range-finders. (125,457.)
11,300. BLACKBURN AEROPLANE AND MOTOR CO., and others. Adjusting or balancing movement of elevators, etc. (125,458.)
11,389. E. T. WILLIAMS. Landing grounds. (125,460.)
11,671. A. H. POLLEN and C. B. CHICKEN. Speed overland and drift indicator. (125,467.)
11,672. A. H. POLLEN and H. F. LANDSTAD. Bomb-dropping sight. (125,468.)
11,737. S. E. SAUNDERS. Driving-mechanism for aerial propellers. (125,469.)
11,815. F. J. HARGREAVES and BLACKBURN AEROPLANE AND MOTOR CO. Controlling mechanism for aircraft. (125,473.)
11,850. FAIREY AVIATION CO. and C. R. FAIREY. Aeroplanes. (125,474.)
12,088. W. AND T. AVERY and A. C. PRATT. Aeroplanes. (125,479.)

Published May 22, 1919

10,451. BARR AND STROUD, A. BARR and W. STROUD. Deflection indicator for anti-aircraft guns. (125,588.)
12,153. J. V. MARTIN. Aircraft running and alighting devices. (125,591.)
12,534. H. B. BENTLEY and BLACKBURN AEROPLANE AND MOTOR CO. Engine cut-out switches. (125,606.)
12,795. R. F. POWER. Device for restraining and releasing aeroplanes. (125,614.)
12,917. VICKERS, LTD., and J. MCKECHNIE. Fabrics for aircraft. (125,617.)

APPLIED FOR IN 1918

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

Published May 22, 1919

4,881. F. J. LEWIS. Aeroplanes. (125,695.)
6,703. J. CORDNER. Propulsion of aircraft. (125,735.)
6,897. D. J. MOONEY. Metal spars and *longerons*. (125,748.)
7,127. T. W. H. WARD. Wings, etc. (125,774.)
7,304. L. JONES. Aeroplanes. (125,784.)
10,317. E. W. PERKS. Streamline fairing for aircraft. (125,827.)
14,145. BOULTON AND PAUL and J. D. NORTH. Aeroplanes. (125,864.)
18,631. T. M. RITCHIE. Airships. (125,893.)

APPLIED FOR IN 1919

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

Published May 22, 1919

2,674. SOC. DES ATELIERS D'AVIATION L. BREGUET. Supporting and releasing tanks for aircraft. (123,085.)

NOTICE TO ADVERTISERS.

IN order that "FLIGHT" may continue to be published at the usual time, it is now necessary to close for Press earlier. All Advertisement Copy and Blocks must be delivered at the Offices of "FLIGHT," 36, Great Queen Street, Kingsway, W.C. 2, not later than 12 o'clock on Saturday in each week for the following week's issue.

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